

17th
MEMOIRS

OF THE

Royal Society ;

Being a New ABRIDGMENT of the

Philosophical Transactions:

Giving an ACCOUNT of the Undertakings, Studies, and Labours of the LEARNED and INGENIOUS in many considerable Parts of the WORLD; from the first Institution of that ILLUSTRIOUS SOCIETY in the Year 1665, to the Year of our LORD 1735 inclusive.

The whole carefully abridg'd from the Originals, and the Order of Time regularly observ'd, with a Translation of the LATIN TRACTS, and the Theoretical Parts apply'd to Practical Uses; also an Explanation of the Terms of ART as they occur in the Course of the Work; being a Work of general Use to the Publick, and worthy the Perusal of all MATHEMATICIANS, ARTIFICERS, TRADESMEN, &c. for their Improvement, in various Branches of Business.

By Mr. B A D D A M.

Illustrated with a great Variety of COPPER PLATES.

V O L. IV.

L O N D O N:

Printed by G. SMITH, in *Stanhope-street*, near *Clare-market*, and Sold by T. COOPER, at the *Globe* in *Pater-noster Row*; J. JAMES, at *Horace's Head*, under the *Royal Exchange*; and W. SHROPSHIRE, in *Old Bond-street*.

M.DCC.XXXIX.

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MEMOIRS

OF THE

Royal Society;

Being a New Arrangement of the

Philosophical Transactions:

Giving an Account of the Undertakings, Studies, and
Labours of the Society, and its various and
considerable Contributions to the World; from the first Institution
of the Philosophical Society in the Year 1662, to
the Year 1700.

Jos. Banks

whose care and industry in the
Collection of the Philosophical Transactions
of the Royal Society, and the Philosophical
Transactions; with an Explanation of the
Terms of Art, and the Philosophical
Terms; being a Work of
great Use to the Publick, and worthy the
Pencil of all
Philosophical Artists, and
for their Improvement, in various Branches of
Natural Philosophy.

By Mr. B. A. D. A. M.

Illustrated with a great Variety of Copper Plates.

VOL. IV.

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Printed by G. Smith, in Strand, near Chancery, and
Sold by T. Cooper, at the Globe in Pall-mall; J. James,
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in Old Bailey.

MDCCLXXII.



M E M O I R S
O F T H E
R O Y A L S O C I E T Y ;

Being a New ABRIDGMENT of the
PHILOSOPHICAL TRANSACTIONS.

Excrefcencies growing on Willow-trees, &c. by M. Leewen-
hoeck. Phil. Transf. N° 269. p. 786.



Leewenboeck took the largest and greenest wil-
low-leaves, and having opened the knotty part
which is found in some of them, he frequently
discovered therein more than one sort of worms;
but none of them being full grown, he cut off some
of those knots, and opened one a little, he saw
a worm therein and he shut it together again; having put several
of these knots into a large glass-tube, that the worms might at-
tain their full growth, he could not find that any of them did so;
he observed at the same time, that several of these knots had no
worms in them, but were almost full of the excrements of the
worms that had been therein, and were dislodged thro' a small
hole, which he could perceive in the knots.

Plate, I. Fig. 1. ABCD represents the leaf of a wil-
low-tree, in which are seven knobs or tumours, some of them
with holes as EFG; another as H; I shows the posture of the
worm, as it lay in the knob M. *Leewenboeck* dissected; he fur-
ther observed, that several of the worms lay dead in the knobs.

and considering what should be the reason thereof, he was at last aware that there was a small worm linked fast to the great one, which small one had no conveniency of getting out, being at both ends of a pointed form, but chiefly in the hinder part; its mouth was screwed into the body of the great worm, from whence he seemed to M. *Leeuwenhoeck* to fetch his nourishment, and by that means occasioned the other's death; M. *Leeuwenhoeck* supposes, that if nature had not made this sort of provision for these animals, they could not subsist, having no feet nor claws proper to fasten on the leaves of trees; how these last worms got into the cavities of those tumors, M. *Leeuwenhoeck* was at a loss; but let us suppose that the first or great worm is produced from an egg, which some fly has laid on a willow-leaf, and that this worm having eat its way thro' the vessels of those leaves, a sort of viscous matter issued therefrom, which intangled the worm, and being dried up together, produced such knobs in the leaves, which inclosed the worms; now some time after, a lesser sort of fly happened to pitch upon the same knob, and made a hole therein, where it laid its eggs, from whence proceeded the above-mentioned little creature, which devoured and lived upon the large worm; in the middle of *July* M. *Leeuwenhoeck* crott several willow-leaves, in which were such like knobs; with these he proceeded, as with the former, and discovered several worms, that were nearly arrived at their full growth: After these knobs had been in the glass-tube about 8 days, he opened one of them, and saw that the worm was turned into a *Tonnekin* or *Aurelia*, and opening some others, he took out 13 or 14 more *Tonnekins*; in some of the knobs he found the small devouring worms above-mentioned, he calls them devouring, because they prey upon a worm at least 50 times bigger than themselves; they were so far advanced in growth that without using any more food, they were ready to be changed into flying insects, which he also put into the glass-tube: M. *Leeuwenhoeck* imagined that these *Tonnekins* were of the same make and texture with that of our ordinary flies; that is, when any of those worms are near their change their skin is contracted, so as to stick close to their body, and this they call a *Tonnekin*, without making any web, as happens to some sorts of insects; these *Tonnekins* were of a darkish red colour; when M. *Leeuwenhoeck* opened one of them, he found the worm lying entire as it was, tho' it had been inclosed in its pellicle or shell above 14 days; but upon viewing some part of the *Tonnekin* with a microscope, he found he was deceived, and that it did not consist either of the web or skin of the said worm, he inclined to believe, that it was rather a part of the leaf itself,

the

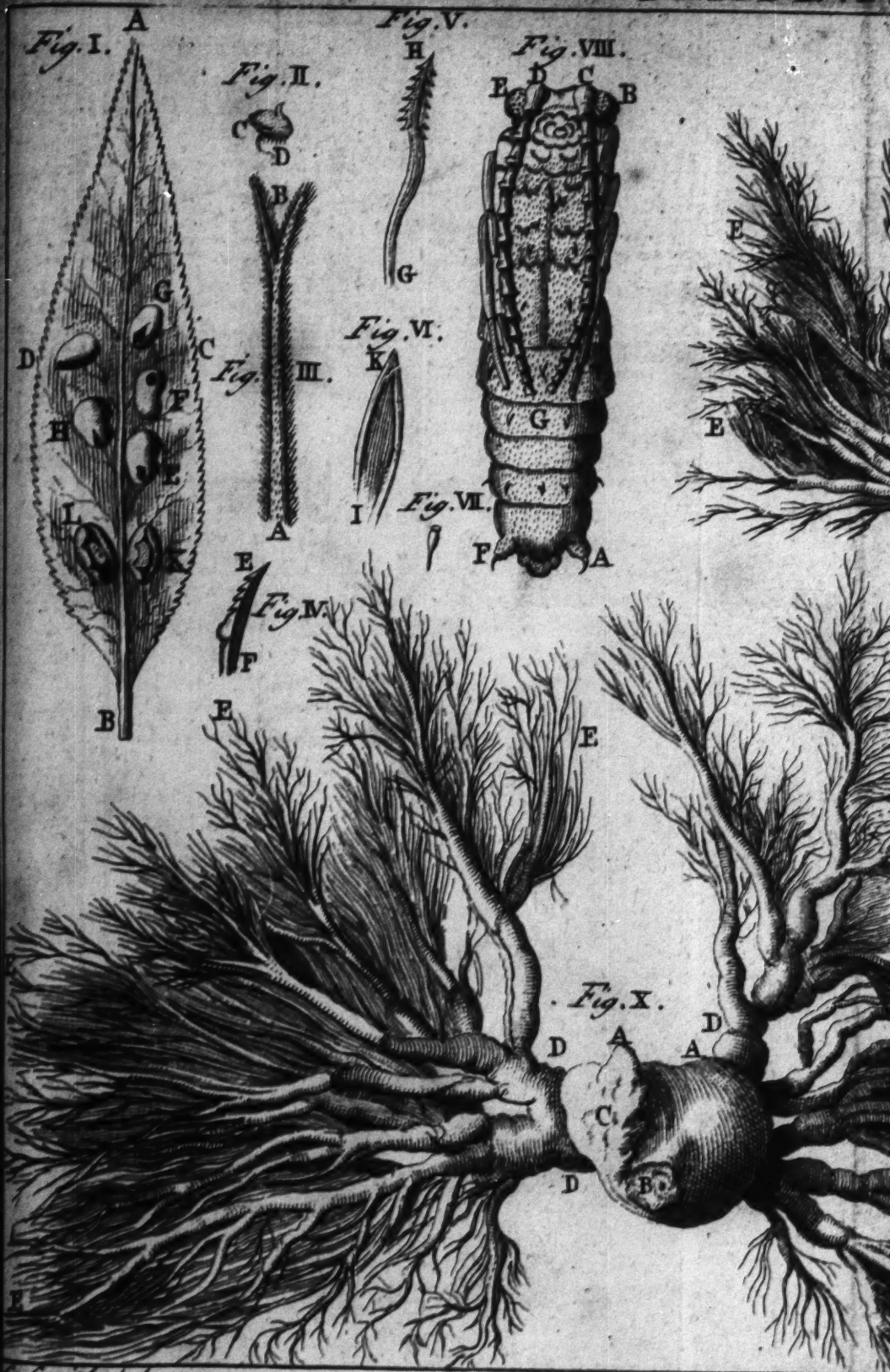


Fig. XI.

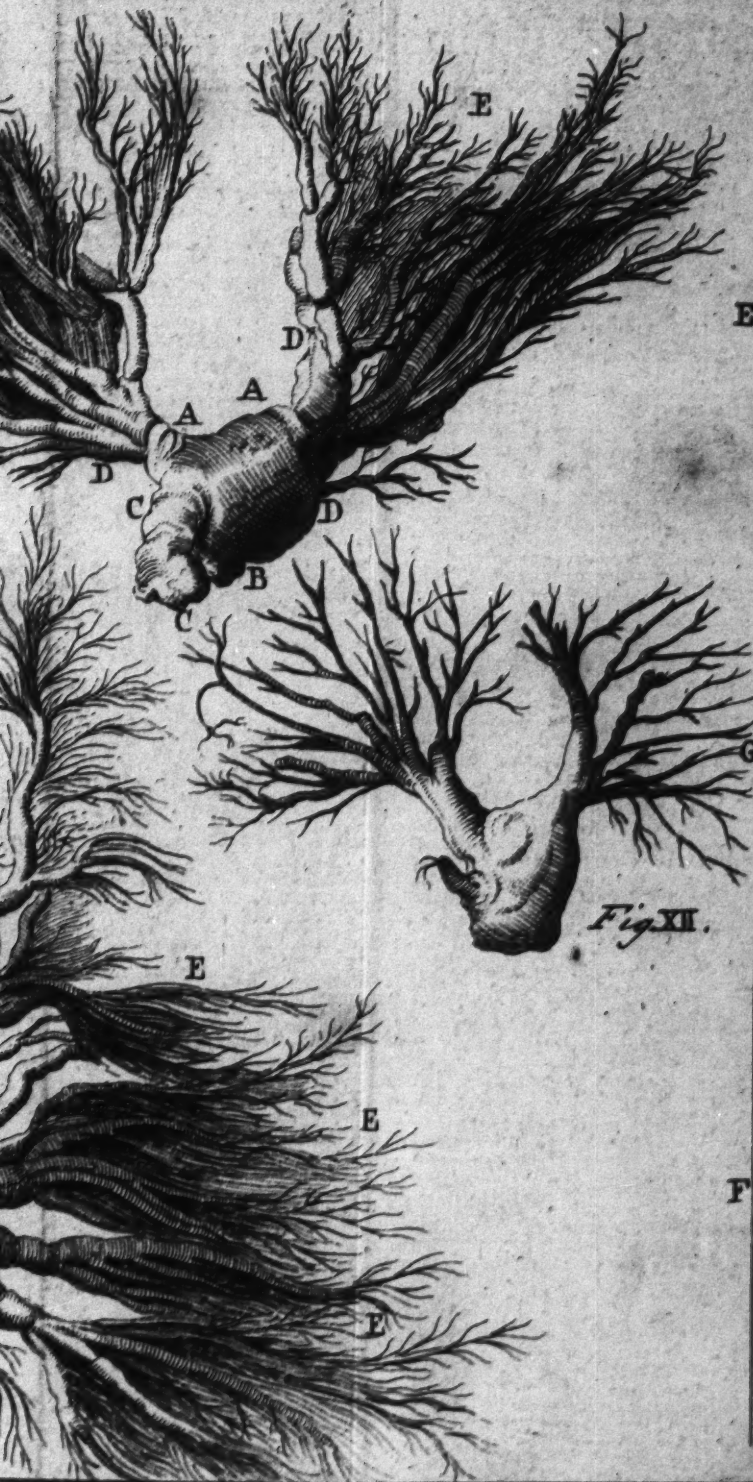


Fig. IX.



Fig. XII.



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the microscope representing its parts like branches, from whence proceeded smaller sprigs; and further, tho' he opened several of those knobs before-mentioned, he did not find one *Tonnekin* therein, excepting in such as he had put in the glass-tube: After some weeks, he perceived certain black flies, proceed from those *Tonnekins*, the hinder parts of their body being of an oblong figure, and fashioned like a hook; the others could not arrive to maturity, but having made a small opening in their pellicle, they just put their heads out, and so died; from the same *Tonnekins* proceeded a second sort of fly, smaller than the former, and not so pointed at the extremity: M. *Leeuwenhoeck* saw two of these small worms (which devoured the large ones) endeavour to shut themselves up in a web; but by reason of the large space, wherein they lay, they could not bring it quite round them, having made it only on one side; but their change happened in so short a time, that he could not make remarks thereon, and as the moths, silk-worms, &c. lie very regularly in a sort of pellicle or membrane with their legs and wings after their change, so in like manner lay the horns and feet of these little animals, each in a particular pellicle, but separate from the body, and after the same manner lay the hinder part of their body, which was shaped much like a hook: These *Tonnekins*, which at first were white, in a few days became blackish, and at last produced that kind of fly with the abovementioned instrument in its hinder part like a hook, which in length amounted to near two thirds of the whole body.

Fig. 2. represents the aforesaid fly, just as it appeared to the naked eye, CD shews the long, slender and hooked part; when M. *Leeuwenhoeck* brought this little instrument before the microscope, it seemed a sort of hook, for it was covered with a great number of fine hairs, as you may see in Fig. 3. and it appeared to M. *Leeuwenhoeck* to be hollow, upon which imagining it might not rather be the case for a hook, he endeavoured to split it, and the hook itself appeared, whose point is only delineated, jagged with teeth like a saw, EF Fig. 4. the more M. *Leeuwenhoeck* viewed this hook, the more he fancied there was another inclosed therein, upon which splitting the first hook, he took out two other distinct hooks, of one and the same shape; a small part of one of them is represented by GH Fig. 5. each hook was fortified with teeth like saws, which he observed was peculiar to them; when he had taken these hooks out of Fig. 4. he was convinced, that that which he took for a hook, was only a second case or sheath for the other two, as may be seen by IK Fig. 6. wherein the hollownes does likewise plainly appear; and there is also a cavity

cavity to be observed in Fig. 5. which M. *Leeuwenboeck* supposed might contain a sharp poisonous liquor.

From this discovery, it is easy to conceive, that such flies do not only lay their eggs on the leaves of trees; but that they also make an aperture in the skin of the leaf, and convey an egg into it, from whence comes the worm, which gnawing the vessels for its sustenance, occasions the sap to flow out of them, and coagulate into that knotty substance; besides, one small fly produced one of these worms, whose hinder part was also hooked, much like that species of flies that proceed from the worms on currant-trees. M. *Leeuwenboeck* took two *Tonnekins* out of the abovementioned knobs in willow-trees, no bigger than grains of coarse sand, in order to describe the shape of such a small animal, but in three hours after he missed them, and concluded, that in that time they were turned to flies and got away; he also took dead worms out of the said knobs, but could not find the lesser sort of worm that use to devour the other, only he observed two oblong white particles upon the dead worm, which were so very small, that they escaped his naked eye; he supposed they were eggs, for he could observe nothing that resembled a worm, and the third day there plainly appeared two worms exactly of the same size and shape with those that devour the larger ones; he took a small devouring worm from a larger that lay dead by it, and from that it took its nourishment, and put it upon a living one, upon which it immediately fastened, whilst the other at the same time used all means, by bending, stretching, contracting, and winding its body, to free itself from this troublesome guest, but in vain, the small worm still keeping its hold; and when it is arrived at its full growth, it is exactly represented in Fig. 7.

Fig. 8. A B C D E F represents a *Tonnekin* which but the evening before had been a worm, and which had cast a very thin skin; and as the body of the worm consisted of so many rings, or circles, so likewise did the *Tonnekin*: In this M. *Leeuwenboeck* not only observed the feet, but even the joints thereof; C G and D G represent its two horns, and tho' they were inclosed in a thin membrane, yet he could clearly see all the joints, which were loose from the body, excepting only at the head; this worm, both before and after its change into a *Tonnekin*, is very white, and some days after the eyes appear of a brownish colour: M. *Leeuwenboeck* often endeavoured to watch the change of these worms, but it is so sudden, that he could never do it: M. *Leeuwenboeck* observed that the mites in cheese turn into *Tonnekins*, and from thence into flies; and farther, when they turn into *Tonnekins*, they

lie

He inclosed in a thin transparent membrane; now this pellicle that covers the *Tonnekin*, is a great defence for the worm within it, which not being able to shut itself up in a web (as several other insects do, before their approaching change, that they may not be devoured by their enemies) without such a pellicle would certainly become a prey to the maggots that swarm in cheeses: M. *Leeuwenboeck* observed that some of the flies produced from cheese-worms, which he kept in a glass, and therein put cheese for them to feed upon, had coupled; and soon after, all of them laid eggs of an oblong figure, and then died; from these eggs came young worms, which also fed on the cheese, and when he judged them to be at their full growth, and the weather began to be cold, he took six of the biggest, and carried them about him, and a few days after, he observed that four were changed into *Tonnekins*, that two worms were dead, and two flies were skipping about the glass; he tried the same thing in *January*, and with the like success; whilst he kept them in the cold, there was little or no sign of life, or motion, but as soon as he put them into his pocket, they were as brisk as in summer; he opened a *Tonnekin* that had never produced a fly, and found a dead one within it, which had been making its efforts to get out, but was not strong enough to effect it.

The Dissection of a Woman who died in Child-bed; by Dr. Peter Sylvester. Phil. Transl. N° 262. p. 717. Translated from the Latin.

M *Duchense* about 40 years of age, was of a plethoric constitution, and had very frequently her *Menses* upon her, even when big with child, but was otherwise very healthful and jolly; having now gone with the twentieth child, when her time drew near, she was seized about 4 o'clock in the afternoon with an extraordinary hemorrhage; M. *James Arnaudin* both a skilful man-midwife and surgeon, being sent for after 9 o'clock, and being told of this flux of blood, he thought no remedy would be of any service in such a dangerous case, before the patient was delivered; after that the patient's strength being quite spent, M. *Arnaudin* was again sent for about midnight, who without any further delay, extracted in less than half an hour a dead female child, the *Secundines* were discharged with ease and were both sound and entire; yet the hemorrhage still continued, which was succeeded by a low pulse, frequent fainting fits, a cold sweat and convulsions; at length about 9 o'clock next morning she died; the following day M. *Arnaudin* opened the *Abdomen*,
and

and upon removing both the *Omentum* which was very fat, and the small intestines, the *Uterus* appeared like a large cupping-glass, very thick and much distended; there was a great *Ecchymosis* in the right broad ligament, which descended from the side of the *Uterus*, where the spermatic and hypogastric vessels are united by an *Anastomosis*, and was most observeable in the inferior part of the neck of the *Matrix*, where it lies upon the *Rectum*: M. *Arnaudin* having cut out the *Uterus* with all its parts, and extracted it out of the *Pelvis*, he laid it on a table; the *Vagina* was very lax, and its internal orifice was so open, as that it could readily receive half the fist; the *Uterus* being cut lengthwise, its bottom was full of some grumous blood, but in other respects sound and entire; and here he could plainly see the adhesion of the *Placenta*, where the internal substance of the *Uterus* was observed to be unequal, thicker and as it were more fleshy; in the lower part of the neck of the *Uterus* appeared the cause of the patient's death; viz. a dilaceration two fingers breadth, which could be seen externally where the *Ecchymosis* was; but whether the *Uterus* was dilacerated by any external cause, or rather by the struggling of the child, as physical writers mention sometimes is the case, M. *Arnaudin* could not tell; but it is certain, that it was from that part that the large vessels discharged that vast quantity of blood; upon separating the coats, and putting a blow-pipe between the duplicature, the blast issued out at several small holes, both from that part of the bottom of the *Uterus* to which the *Placenta* was connected, but especially from the dilacerated part of its neck: M. *Arnaudin* could plainly see the *Cicatrix* in the right ovary, from which, he did not question, but an egg had dropped into the cavity of the tube, which was conveyed by its peristaltic motion into the *Uterus*; the left ovary was flaccid, and exsuccous, the tubes were open on both sides; the round ligaments were strong, and all other things were observed to be sound: Tho' the *Uterus* be suddenly contracted after child-bearing, so that, as M. *Arnaudin* has just now mentioned in this woman, who died about 6 hours after her delivery, it scarce exceeded the bulk of a large cupping-glass; yet with his fingers he could easily stretch it out like a bag; and indeed it is evident that the fleshy fibres being by degrees so much distended and so far separated from each other in the time of the pregnancy, could not for some time after, recover their pristine tone and strength.

M. *Arnaudin* observes by the bye, that the question commonly put amongst anatomists, is almost about nothing; viz. whether the coats of the *Uterus* be thicker in pregnancy, than they are

are in their natural state? M. *Arnaudin* allows indeed, that the substance of the *Uterus* of women not with child, is firmer, thicker and more compact, seeing the fleshy fibres are then shortened and very much contracted; but in women with child, the *Uterus* is much more lax, by reason of the extension of its fibres, and their greater distance from each other; besides, seeing the blood-vessels, whose spiral ramifications in their natural state resemble vine-tendrils, creep along the sides and bottom of the *Uterus*, in the time of pregnancy, they are together with it extended, and so separated from each other; hence it is, that the coats appear thinner; but the ventricle, bladder, and other membranous parts, become thinner by expansion, and why the same should not hold good as to the *Uterus* is plain; for in whatever proportion its coats are extended, in the very same proportion is the great number of its several vessels enlarged, and dilated for the nourishment and growth of the *Fœtus*; besides, the internal substance of the *Uterus*, which is perforated with a great many ducts is at that time thicker, and chiefly so, at its bottom where the *Placenta* adheres; and this is also very manifest in animals that have cotyledons; the occasion of the mistake, M. *Arnaudin* takes to be this; viz. that opening the body soon after delivery, at which time the *Uterus* is contracted, and its vessels swelled and distended with blood, anatomists might hereby be led to think that the coats of the *Uterus* in pregnant women were twice as thick as they are in their natural state.

That peculiar distribution of the blood-vessels in the *Uterus*, which M. *Arnaudin* has mentioned above, is very observable; for the spermatic and hypogastric arteries and veins are curiously curled, and contorted, like so many vine-tendrils, on the bottom, and sides of the *Matrix*; hence they may be extended not only in the same manner as the *Uterus*, but also in the latter months of pregnancy, when they approach nearer to a right line, the blood is more easily conveyed and distributed thro' them; and how much this contributes to supply that quantity of nutritious juice, which is requisite to nourish the *Fœtus* when advanced in growth, would be superfluous to farther explain.

An Account of Dr. Hook's Marine Barometer by Mr. E. Halley. Phil. Trans. N° 269. p. 791.

DR. *Hook*, who has made several attempts to improve the mercurial barometer, and render the minute divisions on the scale thereof more sensible, judging that it might be of great use at sea, contrived several ways to make it serviceable.

VOL. IV. 1

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aboard

aboard ship: The mercurial barometer, requiring a perpendicular position, and the quick-silver vibrating therein with great violence upon any agitation, is therefore unfit to be used at sea: It is about 40 years since, that the thermometer of *Robert de Fluctibus*, depending on the dilatation and contraction of included air by heat and cold, has been disused, upon discovering that the pressure of the air is unequal; that inequality mixing itself with the effects of the warmth of the air in that instrument; and instead thereof was substituted the sealed thermometer, including spirits of wine (first brought from *Italy* into *England* by *Sir Rob. Southwell*) as a proper standard of the temper of the air, in relation to heat, and cold; that aethereal spirit being of all others, that are yet known, the most susceptible of dilatation, and contraction, especially with a moderate degree either of heat or cold; now this being allowed as a standard, and the other thermometer that includes air, being graduated with the same divisions, so as at the time when the air was included, to agree with the spirit-thermometer in all the degrees of heat and cold, observing at the same time the precise height of the mercury in the common barometers; it will readily be understood, that whenever these two thermometers shall agree, and the pressure of the air is the same it was when the air was included, and the instrument graduated; that if in the air-thermometer, the liquor stand higher, than the division mark'd thereon, corresponding with that on the spirit-glass, it is an indication that there is a greater pressure of the air at that time, than when the instrument was graduated; and the contrary is to be concluded, when the air-glass stands lower than the spirits; viz. that then the air is so much lighter, and the quick-silver in the ordinary barometers lower, than at the said time of the graduation; and the spaces answering to an inch of mercury will be more or less, according to the quantity of air so included, and the smallness of the glass tube, in which the liquor rises and falls, and may be augmented almost in any proportion, under that of the specific gravity of the liquor in the thermometer, to that of mercury; so as to have a foot or more for an inch of mercury, which is another great conveniency.

It has been observed by some, that in long keeping this instrument, the air included, either finds means to escape, or deposits some vapours mixed with it; or else, by some other cause becomes less elastic, whereby in process of time it gives the height of the mercury somewhat greater than it ought;
but

but this, should it happen in some of them, hinders not the usefulness thereof, for that at any time may very easily be corrected by experiments; and the rising and falling thereof are the things chiefly remarkable in it, the just height being a mere curiosity: In these parts of the world, long experience shews us, that the rising of the mercury forebodes fair weather after foul, and an easterly or northerly wind; and that the falling thereof, on the contrary, signifies southerly or westerly winds, with rain, stormy winds, or both; which latter is of much more consequence to provide against at sea, than at land; and in a storm the mercury beginning to rise, is a sure sign that it begins to abate; as has been found in high latitudes both to the north and south of the equator.

Plate I. Fig. 9. A B represents the spirit-thermometer, graduated from 0 or the freezing point, thro' all the possible degrees of the heat or cold of the air, at least in these climates; C D is the air-thermometer, graduated after the same manner, with the like degrees; E F is a plate applied to the side of the thermometer C D, graduated into spaces, answering to inches, and parts of an inch of mercury, in the common barometers; G an index standing on the plate, at the height of the mercury, as it was when the instrument was graduated, as suppose here at 29 inches and a half; L M a wire, on which the plate E F slips up, and down, parallel to the tube of the thermometer C D; K any point, at which the spirits stand at the time of observation, suppose at 38 on the spirit-thermometer; slide the plate E F, till the index G stand at 38 on the air-thermometer, and if the liquor therein stand at 38 likewise, then is the pressure of the air the same, as at the time of graduation, viz. 29, 5; but if it stand higher, as at 30, at I, then is the pressure of the air greater, and the division on the sliding plate against the liquor, shews the present height of the mercury to be 29 inches 7 tenths: Mr. Halley had one of these barometers in his southern voyage, which never failed giving early notice of all the bad weather they had.

A Polypus in the Vena Pulmonalis; and the Structure of that Vessel by Mr. Wm. Cowper. Phil. Trans. N^o 270.

P. 797.

MR. Cowper took a *Polypus* out of a child about a year old; its first observable disorders were a quick pulse, and a difficulty of breathing; in about four days its gums were observed to be swelled, for which they were cut, and

all symptoms disappeared for five or six hours, after which they returned: Notwithstanding blood letting, and the application of other remedies, the difficulty of breathing increased, the pulse became still lower and quicker, and in four days more the child died.

The body was open'd, and the *Viscera* of the lower belly were found well constituted; in the *Thorax*, the *Thymus* exceeded the natural size even in children; the fore-part of the lungs appeared to be well disposed, but the back parts were very hard, and much inflamed; upon making an incision on the diseased part, purulent matter followed the knife in such quantities from divers cells, that it filled the wounds as fast as they were made, and the pieces cut from it sunk in water; but as we approached nearer to the parts unaffected, the pieces became gradually more buoyant, till at length we came to the fore-part, which floated; the cavities of the right auricle and ventricle of the heart were filled with a *Polypus*, which was continued into the superior, and inferior trunks of the *Vena Cava*; upon opening the *Vena Pulmonalis* at the basis of the heart, Mr. *Cowper* found it there entirely filled with a *Polypus*, or coagulation of blood, which was continued into all its large branches in the lungs, and were easily extracted, and when laid open, appeared, as represented, Plate I. Fig. 10.

This *Polypus* affords us a better idea of the contrivance, and structure of the pulmonary vein, than any figures thereof yet published; for tho' in different subjects of the same species we meet with frequent varieties in the distribution of the blood-vessels, especially of the veins; yet we no where find a more constant regularity, and uniformity, than in the trunks, and large branches of the pulmonary vein, of which Mr. *Cowper* has given two figures, Fig. 10. and 11. drawn, after a preparation of that vein injected with wax, and freed from the lungs in an adult human body.

The left auricle of the heart in human bodies in Fig. 10. and 11. being much less than the right, it was necessary that that part thereof next the basis of the heart should be very large as A A B; lest the sudden strong motion of the *Systole*, should make the reflux blood to recoil in the branches of this vein D D E E, and prevent a ready supply in the succeeding *Diastole* of the heart; but the weight of so much blood lying in the trunk of this vessel A A B effectually prevents its retrocession in the lateral branches within the lungs, as D D E E, and the more, because the orifices of those branches D D are

not

not diametrically opposite at A A to the mouth of the vessel on the basis of the heart B, its lateral branches making acute angles with the trunk, as represented in Fig. 12.

An Account of uncommon Convulsions; by Dr. John Friend. Phil. Transl. N^o 270. p. 799. Translated from the Latin.

AT *Blackthorn* in *Oxfordshire*, five little girls were seized with frequent fits of barking like dogs, together with violent motions of the head; no convulsions were observed in their faces, only frequent distortions and oscillations of the mouth; their pulse was like that of persons in health, but that towards the end of the fit it was somewhat weaker; the noise, as it seem'd to the Dr. did not resemble, the barking of dogs so much, as their howling, only that the returns were more frequent, with alternate sobbings; the youngest of the girls was but six, and the eldest 15 years of age; at intervals they had their reason and senses entire; but it was not long ere one of them, renewing her yelling, would affect the rest; at length their spirits being exhausted they would fall down like epileptics upon a couch laid in the middle of the room to receive them; for some time they would lie quietly and decently, but upon a new irritation or orgasm of the spirits, they would beat their breasts and other parts, and discommode each other.

July 12. 1700. Dr. *Friend* visited another family at *Blackthorn*, where a boy and three girls had been seized with convulsions ten weeks before, without any apparent preceeding cause; at first one of the girls was affected, and the first fit lasted for two hours; and the rest, as the mother informed him, were so struck with their sister's disorder, that in a few days they were also seized therewith; at his arrival they were all before the doors upwards of half an hour at play, very brisk and unconcerned, and their complexion laudable; from this disorder was produced no other bad effect than a little weakness and langour, their pulse was in every respect regular; at length the eldest girl, about fourteen years of age was seized as usual; the only symptom of its approach, was a swelling of the stomach, which rising gradually, like a ball, up the throat, set the muscles of the larynx and head upon their wonted convulsions; this rising was a certain and constant fore-runner of the paroxysm; and if they endeavoured to stop it, it broke out with the greater violence, and continued the longer: The noise they made, which was incessant, and disagreeable, did not so much resemble the barking or howling of dogs, as had been

been given out, as an uncouth kind of singing, consisting of three notes or tones, repeated twice over, and succeeded by deep sighs which ended in a plain note, that was much stronger and sharper than any of the rest; no words can describe this song; at intervals she varied her note, but when her spirits began to fail, her motions and bawling increased, till being at length almost choaked, she would express a note or two, and repress a little the shaking of her head; by this means recovering strength, she would renew the same ditty, which was always accompanied with an alternate nodding of the head backwards and forwards; the muscles of the neck were very tense and inflated; all the other parts of the body were free of convulsions; all the time of the paroxysm she had her senses entire, and would sit or walk, as she pleased, but could not utter one word; her complexion did not change, her eyes were immovable as if dead; she had no distortion but in her mouth, which by reason of the contraction of the muscles was quite a *Spasmus cynicus*; during the paroxysm you could scarce feel a pulse; and thus she continued upwards of half an hour; tho' the brother and sisters stood by, yet they were not seized with the *Spasmus* as usual: They slept pretty well in the night, provided they were inclined to it, when they lay down; but if not, they were seized with the paroxysm till morning, at the same intervals as in the day time; the girls of the other family were troubled with this disorder about the beginning of the year, at which time their mouth was distorted and swelled; and a little after that these just mentioned, had convulsions, the others were seized with epileptic fits and a total deprivation of sense; they would sometimes, as if they were possessed, beat upon their breasts, and at other times run about, &c. but there was nothing of this the first three months, only the symptoms the Dr. has already described.

The uncommon appearance, or long continuance of these symptoms does not hinder concluding that this is a natural disorder; for this *Spasmus* agrees with all other convulsions; as arising from the irregular motions of the animal spirits within the nerves, variously contracting the muscles according to the disposition of the orgasm; so that in this case nature does nothing but what is usual in other kinds of convulsions; using the same organical motions here, as in the *Chorea S. Viti*, or in hysteric disorders, where the patient is at one time seized with laughing, at another with howling, and at another time beats upon the breast; all which is occasioned by the various and involuntary motions of the muscles; seeing therefore the muscles of the larynx, head, hands, and

and feet are equally disposed to convulsions, whatever seems to be strange and uncommon in these girls, is owing not so much to the nature of the symptoms, as to the part affected.

A Water-spout observed in the Downs; by Mr. Patrick Gordon. Phil. Transl. N° 270. p. 805.

MR. Gordon observed between the hours of 10 and 11 in the forenoon a remarkable water-spout in the *Downs*; it bore N. by E. off the ship he was in, and about two leagues distance by estimation; the wind at E. N. E. a top-sail gale, and very cold; the horizon was entirely open and serene, except its northern parts from N. N. W. to N. E. by E. or thereabouts; the highest part of the cloud appeared to make an angle of 45 deg. of elevation; the upper half of the cloud was very white, and the other extremely black; the spout itself, which hung from the lower part of the whitish cloud, hovered up and down for about 20 minutes, and for two or three minutes, that part of the sea exactly under the spout, sparkled up water to a considerable height; the sparkling run along to the leeward (the cone of the spout moving that way, and making, it seems a discharge, tho' not visible to us) and continued running along for six ships length; afterwards the body of the spout did quickly contract itself, and then it disappeared; about two hours afterwards the heavens were intirely overcast, and during that afternoon there fell abundance of hail, and both the wind and cold increased: Mr. Gordon had seen several water-spouts in the *Mediterranean*, and those usually during the time of a stark calm, and in hot summer weather; but to see one in our northern climate in *March*, whilst the weather is both cold, and windy, is he presumes, a little unusual.

Observations on Insects in Virginia; by Mr. John Bannister, with Remarks thereon by Mr. Ja. Petiver. Phil. Transl. N° 270. p. 807.

I. *Vespe Ichneumon*es, of which there are in *Virginia* divers kinds, all of them long, and slender-waisted; they make their nests of dirt, and are therefore called dirt-wasps; some of them make their nests contiguous to one another, each adjoining cavity having in it two or more partitions; others build them in clamps one upon another, they fix them against a wall or cieling of a house, or any where that is dry; there is not above two wasps belonging to each waspary; for when they have made one cell, and put therein six or eight live spiders, they close it up to work upon another, leaying them to brood upon their young, some-

something like that *Aristot. Hist. Animal. lib. 1. cap. 20*; the young ones of these are inclosed in a thin transparent horny pellicle of the colour of amber; those of the other are included in a brown case, with a certain number of regular protuberances at one end thereof; some again lie in brown ones, that are smooth, and some are without any case. *vid. Mart. Lister Hist. Anim. Cap. 5.*

2. There are several other colour'd wasps; two black and white, that build their nests on the small branches of trees; of the lesser kind of nest there is a very good figure, and description in *Pisô's Nat. Hist. of Brasil, lib. 3. cap. 12. p. 287*, only that as it seems to stand erect, it should have been made pendulous; this is of an oval form, and about the bigness of a goose-egg; the other is much larger, and more round; the wasps also are somewhat bigger: Mr. *Bannister* found a third sort both in shape and colour like the common *English* wasp, whose little nest was half round, like a clock-bell, fixt under the covert of a rotten log; the colour of these nests resembles brown paper, only the last inclines to the colour of sulphur; some of the wasps here are brown, with purple wings; and others, have streaks of yellow under their belly; these make their cells of the same matter with the former; but they are without any cover, and therefore they chuse the shelter of a house, &c. tho' Mr. *Bannister* has seen them sticking in a bush; here are also some philamot ones with purple wings, and other large ones black, and yellow, with a mouth like a brieze or stout, and one red, and black without wings, whose sting is very long; this last is a very singular wasp, which may not improperly be called *Vespa Virginiana impennis, ex nigro rubroque mixta*.

3. *Bombylus Teredo*; these bees eat into timber, and make their nests therein; this Mr. *Bannister* had, was in the joist of a house, so firm and sound, that it was hard boring it with a piercer; the hole was but just big enough for the bee to creep in at, going streight up about two inches in the wood, and then transversely, at least half a foot on each side, which seem'd to him (having probed it with a knitting-needle) to be twice as wide as the entrance; how many bees belong'd to it he could not tell, there were three within, and he heard one or two about the hole.

4. *Oestrum*; perhaps it is the same with *Asilus Virginienfis Pennei*.

5. *Musca carnivora vivipara*; a small brown fly that discharges live maggots.

6. *Cicadae* & earum *Exuviae*, *Mouffet*, p. 130. Mr. Bannister thinks, that those insects which destroy'd the trees in New-England, were *Cicadae*; but Mr. Petiver had a large *Cicada* from Maryland, exactly agreeing with the two uppermost larger ones figured in *Mouffet* p. 130, on the right hand, which he cannot think were these that destroy'd the trees, because they have no *Forcipes*, or other grinders to eat the leaves, but only a tube, thro' which they suck in dew, which is all the nourishment he could ever find they live upon, and most writers confirm the same; as *Mouff. c. 17. p. 127. Virgil* and *Theocritus*; and therefore he calls them dew-flies, rather than grasshoppers.

7. *Locustae*, or grasshoppers; *Barrard. in Exod. 667. 8.* Mr. Petiver had from these parts a very uncommon kind, whose wings were entirely green, and without any spots or veiny reticulations, as the common large ones always have, for which reason he distinguishes it by the name of *Locusta Americana major alis viridibus opacis*; one of which Dr. Sloane brought from Jamaica.

8. *Mantis*; it is neither of the tree *Mouffet* describes p. 118, nor are the two figures in his appendix like it; that of *Piso* resembles it most, *lib. 5. cap. 21. p. 317*, but his from an insect becomes a vegetable, which Mr. Bannister cannot aver of this.

9. *Blattae*; these cock-roaches are one of the plagues of this country, they are oviparous, and large; the *Peruvians* call them *Araners*, *Mouff. p. 139*; but Mr. Petiver rather thinks he meant the *Brasilians*, and that his *Serius* should be *Lorius*, who wrote a voyage to *Brasil* in French, Anno 1594, where p. 159, he calls them *Arauners*; *Clusius* also in his *Exotica*, p. 306, in his notes on *Monardes* takes notice of the same.

10. *Blatta volans*; these are very rare, Mr. Bannister saw but one.

11. *Cimices*, or wall-lice; these are another of their plagues, for where there is not great care taken to destroy them, they are as numerous in their beds, as the former are in their kitchens.

12. *Cicindela mas*, the fire-fly; *Cicindela Mariana vaginâs teneris fuscis, marginibus fulvis*. This is not that large *Virginian* kind, whose head shines, nor is it that smaller sort, which according to *Piso*, the *Brasilians* call *Memoa*, nor the common sort, tho' much of that shape and size; this emits its light at two crescents, but the whole tail of the other shines, which it contracts or dilates at pleasure; its sheath-wings are of a dark purple colour, edged with yellow, as also its head or helmet; Mr. Petiver observes, that this is the same with several he had

from Maryland and Carolina; yet he found a variety amongst those from Carolina, some of whose sheaths were entirely blackish, but their helmet edged with yellow, and which he distinguishes by the name of

13. *Cicindela Caroliniana, vaginis omnino nigricantibus.*

14. *Cicindela fœmina*, or glow-worm; its back and head are armed in a joint-armour of a deep murray-colour, fastned to the Thorax; the tail consisted of nine shelly rings, in the last of which were visible the two shining points; its head was black, and so small that its texture could not be perfectly discerned without a glass; its eyes (if it has any) resembled those of a snail, standing on the extremity of both horns; it had six legs.

15. *Scarabæus mas seu minor cornibus latis*, Moff. 149.

16. *Scarabæus niger ore cornuto seu forcipato, capite & scapulis colore succineo elystris luteis eleganter notatis.*

17. *Scarabæus ore cornuto elystris purpureis, scapulis nigris scuti more cavis*; Mr. Petiver observes, that this beetle is found amongst rotten wood, and logs, and when taken, it makes a squeaking noise.

18. *Scarabæus Nasicornis ore cornuto.*

19. *Scarabæus Melolanthæ Nasicornis.*

20. *Scarabæus magnus nostras, ex nigro eleganter albo depictus*; Mr. Petiver observes that this beetle is found on a rotten log, 60 miles above the habitable parts of James's river.

21. *Scarabæus cornibus obtusis.*

22. *Scarabæus cornibus acutis*; this is the holy beetle in *Tab. Hieroglyphica* mentioned by Mr. Gregory in his preface; there are great numbers of them here in the summer-time; Mr. Bannister has often look'd into their rolling pellets, yet he could not find any alteration in the mass of matter by its motion; till at length he met with one of these deserted balls, in the centre of which lay a small white grub, that possibly might owe its life to the motion; and afterwards he found in one of these balls two very small young beetles, differing in nothing from the old one, but in bigness.

23. *Scarabæus stercorarius alter, ore forcipato.*

24. *Scarabæus stercorarius capite, scapulis, & elystris, quasi sculptura excavatis*; whether it be the *Cantharus Carolinianus obscurè cuprosus, vaginis inequalibus*, Mr. Bannister cannot tell.

25. *Scarabæus stercorarius*, that flies only in the night-time.

26. *Scarabæus melolanthæ*; this and that other dung-beetle amongst the *Nasicornis* may, Mr. Bannister thinks, be very aptly rank'd with those of this kind.

27. *Scab.*

27. *Scarabæus luteo-viridis*; they are found amongst *James's* town weed, i. e. *Scrammonium*.

28. *Scarabæus minor viridi-ceruleus*; these lie amongst the flowers of the *Apocynum*.

29. *Scarabæus colore viridi, auro radiante, & luteis maculis eleganter notatus*; Mr. Bannister does not know whether the three last mentioned beetles may not be *Cantharides*.

30. There is also a smaller kind, all black.

31. *Scarabæus colore griseo, scapulis binis quasi oculis nigris mollitie pubescentibus notatus*; it is found amongst rotten wood, and is called a snapper, from the noise it makes, by thrusting part of its neck into its breast, and springing back again; it somewhat resembles the *Cicindela Virginienfis* of *Mouffet*, but its head does not shine.

32. *Scarabæus arboreus pilosus*.

33. *Scarabæus arboreus minor glaber*; these two kinds, they say, the *Indians* eat.

Mr. *Petiver* had also the following beetles, viz.

34. *Buprestis Mariana viridis, vaginis sulcatis, & punctatis*.

35. *Cantharus Carolinianus niger, undis pallescentibus*.

36. *Cantharus Marianus viridis perelegans, vaginis sulcatis, signaturis flavescentibus ornatus*.

37. *Cantharus Marianus minor, vaginis ex nigro, flavoque striatis*.

38. *Capricornulus Carolinianus vaginis ex nigro, luteoque mixtis*; this has its shoulders black, and only edged with yellow, and its sheath-wings equally mixt, whereas that from *Maryland* has most black in its sheaths, and a yellow ring round the middle of the *Scapula*.

39. *Crio-ceros marianus castanei coloris antennis tortilibus membranaceis*; this resembles the second figure in *Mouffet* p. 153.

40. *Crio-ceros marianus castanei coloris, antennis tenuioribus geniculatis*; this is slenderer than the last, both in the body, but especially in the horns, otherwise very like it; Mr. *Bannister* believes they are male and female.

41. *Curculio Carolinianus ruber, maculis nigris*.

42. *Melolanthes Marianus maximus maculatus*.

43. *Melolanthes Marianus viridis, marginibus flavis*.

44. *Nasicornis Tauroceros Marianus splendens castanei coloris*.

45. *Scarabæus Carolinianus, oblongus, niger, forcipatus vaginis striatis*.

46. *Scarabæus Carolinianus, subrotundus, niger, levis.*
 47. *Scarabæus Marianus*, like our louse; its *Sulci* or furrows on the *Vagina* are larger, but otherwise very like N° 9. in *Bannister's Museum* p. 4.
 48. *Scarabæolus Carolinianus nigro flavoque mixtus.*
 49. *Testudinulus Carolinianus, flavus margine transparente.*
 50. *Phalena magna, cinerea, cruribus spinulis armatis*; the horn worm-fly, so denominated from a horned *eruca*, or caterpillar, that feeds on green tobacco, and towards the fall creeps into the ground, and becomes an *aurelia* of a reddish brown colour, in which the *proboscis* of our moth has its *involucrum*, &c.
 51. *Tinea Scorpiuncularis, libros depascens*; *Mouffet* in two several places tells us of such an insect, which he has described in his chapter of scorpions p. 172. whether ours is that he means, Mr. *Bannister* cannot tell; it has eight legs besides its claws; it creeps very fast, both backwards, forwards, and sideways, and is found in old musty books.
 52. *Phalangium imperati*, descrip. 681, fig. 692. *Mouffet* in his appendix has given two figures of this spider, in that which shews its fore-parts, you have the site and position of the four larger eyes, but the four smaller ones, lying in a streight line under them, which are also discernible to the naked eye he has omitted.
 53. *Phalangium alterum*, with four large eyes in the segment of a circle, bending upwards, and as many smaller ones disposed in like manner below in the fore-head.

The Spawn of Cod-fish, &c. by M. Leewenhoek. Phil. Trans. N° 270. p. 821.

ABOUT the middle of *January* M. *Leewenhoek* observed for several days the spawn or hom of a live cod-fish; but he could not bring the *Animalcula* to such a position, as to have a full and perfect view of them, not only by reason of their wonderful smallness, but also because their bodies were so tender and soluble, that when he diluted the *Semen* or spawn with rain water, in order to separate them from each other, and afterwards exhaled the watry parts, their little bodies burst into pieces, after which M. *Leewenhoek* could only see the tail; the oval small parts he concluded to be the *Animalcula* turgid with water, and burst to pieces; and the broken parts seemed to be four times as large as the entire body of one of them: In another place, where several of these *Animalcula* lay together, they appeared like
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bright bubbles, lying in a watry slimy matter, inclosed in a circular pellicle, or membrane: M. *Leewenhoek* has observed more than once the aforesaid *Animalcula* in the spawn of several cod-fish, wherein he little expected to find them living, because the seed was not newly come from the fish; but squeezed out of the *Vasa deferentia*, and exceeding thick; he discovered a vast number of exceeding small creatures, alive and swimming together, having often viewed them so long, till the liquid matter in which they swam was quite exhaled, and the *Animalcula* dead; and where they were dispers'd a little, they had burst asunder; but where they lay thicker, and closer together, he could not perceive the broken pieces of their bodies: Whilst he observed these *Animalcula*, without putting them into any liquor, they seem'd smaller than when M. *Leewenhoek* had view'd them in a round glass-tube: In order to represent their smallness, M. *Leewenhoek* took one of the hairs of his head, and placing it near the *Animalcula*, the hair appear'd thro' his glass to be an inch broad, so that at least 60 of those *Animalcula* could easily lie within its diameter; this being suppos'd, and their bodies being allowed to be, as they are, spherical, M. *Leewenhoek* computes that 216,000 of them are equal to a globe, whose axis does not exceed such a single hairs breadth; as for the tails, he judg'd them to be as long, as those of the *Animalcula* found in the male seed of a ram; one cannot easily perceive those tails, and M. *Leewenhoek* could not see the tips or smaller ends thereof; for as all tails are thickest in that part, which immediately joins the body, these, even there, were not so thick, as the tip of the tails of the above-mentioned *Animalcula*: Whereas, there is a vast difference in the consistency of the skin, flesh, and bones of a cod-fish, when compar'd with the same parts in a sheep, or other land-animal; so likewise M. *Leewenhoek* observ'd, that the same may be assert'd of the several kinds of *Animalcula* found in the male seed of different animals; for, of the several thousands he took out of the testicles of a ram, he never found any that broke to pieces; tho' several of their bodies, after the exhalation of the moisture, might be observ'd flat, &c. M. *Leewenhoek* attempted several times to take off the uppermost skin of some of these *Animalcula* of a ram (which he had kept five months together upon glass before his microscope) with a very fine pencil dipt in water, in hopes of making farther discoveries, but he could not succeed.

In January, M. *Leewenhoek* took a live cod-fish, and finding that its seed came very thin from it, with a little pressing, he took

took a drop thereof, wherein he discovered a vast number of *Animalcula*; he repeated his observation the same evening, with the same success, but next day he could find none of them alive; and whereas, he had laid that drop upon a small copper-plate, he supposed that the exhalation of the moisture might be the occasion of their death, and not the coldness of the weather, which at that time was very moderate: In the beginning of April M. Leewenhoeck took the male seed of a jack or pike, but could discover nothing more than in that of a cod-fish, but having added four times as much water in quantity, as the matter itself was, and then making his observations, he could perceive, that the *Animalcula* did not only become stronger, and swifter, but he saw them move with the same celerity, a river fish does, when chased by an enemy just ready to devour it; it is observable, that this whole course was no longer than the diameter of a single hair of a man's head.

A Scale of the Degrees of Heat. Phil. Transf. N^o 270. p. 824.
Translated from the Latin.

0			T HE heat of the air in winter, when the water begins to freeze; and it is discovered by exactly placing the thermometer in compressed snow, at the time it begins to thaw.
0, 1, 2.			The heat of the air in winter.
2, 3, 4.			In the spring and fall.
4, 5, 6.			In summer.
6			The heat of the air at noon about the month of July.
12	1		The greatest degree of heat the thermometer received on the contact of a man's body, as also that of a bird hatching her eggs.
14 $\frac{1}{2}$	1 $\frac{1}{2}$		Almost the greatest degree of heat of a bath, which a man can bear by moving his hand therein for some time; and that of blood newly drawn is nearly the same.
17	1 $\frac{3}{4}$		The greatest degree of heat of a bath, which a man can bear for some time without stirring his hand therein.
20 $\frac{1}{2}$	1 $\frac{3}{4}$		The heat of a bath whereby melted wax swimming thereon, by cooling hardens and loses its transparency
24	2		The heat of a bath, whereby wax swimming thereon, is melted by growing hot, and kept in continual fusion without ebullition.

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28 $\frac{1}{2}$	2 $\frac{3}{4}$	The mean heat between that whereby wax melts and water boils.
34	2 $\frac{1}{2}$	The heat whereby water has a strong ebullition, and a mixture of two parts of lead, three of tin, and five of tin-glass, by cooling hardens; water begins to boil with a degree of heat of 33 parts, and by boiling scarcely acquires any greater degree than that of 34 $\frac{1}{2}$; but iron growing cold, with the heat of 35 or 36 parts, when hot water, and 37, when cold water is dropp'd thereon ceases to cause any ebullition.
40 $\frac{1}{2}$	2 $\frac{3}{4}$	The least degree of heat, whereby a mixture of one part of lead, four parts of tin, and five parts of tin-glass, by growing hot is melted, and kept in continual fusion.
48	3	The least degree of heat, whereby a mixture of equal parts of tin and tin-glass is melted; this mixture, with the heat of 47 parts, by cooling coagulates.
57	3 $\frac{1}{4}$	The degree of heat, whereby a mixture of two parts of tin and one part of tin-glass is melted, as also a mixture of three parts of tin and two of lead; but a mixture of five parts of tin and two of tin-glass, with this degree of heat, by cooling hardens, and in like manner a mixture of equal parts of lead and tin-glass.
68	3 $\frac{1}{2}$	The least degree of heat, that melts a mixture of one part of tin-glass and eight parts of tin; tin by itself is put into fusion with the heat of 72 parts, and by cooling hardens with the heat of 70 parts.
81	3 $\frac{3}{4}$	The degree of heat that melts tin-glass, as also a mixture of four parts of lead, and one part of tin; but a mixture of five parts of lead and one part of tin, when melted, and cooling again, it hardens with this heat.
96	4	The least degree of heat that melts lead; lead, by growing hot, is melted with the heat of 96 or 97 parts, and cooling, it hardens with 95 parts.
114	4 $\frac{1}{4}$	The degree of heat, whereby ignited bodies, in cooling, quite cease to shine by night; and again, by growing hot, begin to shine in the dark, but with a very faint light, which is scarcely perceptible; in such a degree of heat there melts a mixture of equal parts of tin, and <i>Regulus Martis</i> , and

		and a mixture of seven parts of tin-glass and four parts of the said <i>Regulus</i> by cooling hardens.
136	4½	The degree of heat with which ignited bodies glow by night, but not at all in the twilight; and with this degree of heat both a mixture of two parts of <i>Regulus Martis</i> and one part of tin-glass; as also, a mixture of five parts of the said <i>Regulus</i> , and one part of tin by cooling hardens; the <i>Regulus</i> by itself hardens with the heat of 146 parts.
161	4½	The degree of heat whereby ignited bodies manifestly glow in the twilight immediately preceeding the rising of the sun, or after his setting, but not at all in a clear day, or but very obscurely.
192	5	The degree of heat of live coals in a small kitchen-fire, made up of bituminous fossils, and that burn without using bellows; as also, the heat of iron made as hot as it can be in such a fire; the degree of heat of a small kitchen-fire made of faggots, is somewhat greater, viz. 200 or 210 parts; and that of a large fire is still greater, especially if blown with bellows.

In the first column of this table are the degrees of heat in arithmetical proportion, beginning with that which water has when it begins to freeze, being as it were the lowest degree of heat, or the common boundary between heat and cold; and supposing that the external heat of the human body is 12 parts; in the second column are set down the degrees of heat in geometrical proportion, so that the second degree is double the first, the third double the second, and the fourth double the third; and let the first degree be the external heat of the human body in its natural state: It appears by this table, that the heat of boiling water is almost thrice greater than that of the human body, of melted tin six times, of melted lead eight times, of melted *Regulus* twelve times, and the heat of an ordinary kitchen fire is sixteen or seventeentimes greater than that of the human body.

This table was constructed by the help of the thermometer, and red hot iron; by the thermometer were found all the degrees of heat down to that whereby tin is melted, and by the hot iron were discovered all the other degrees; for the heat which hot iron, in a determinate time, communicates to cold bodies near it, that is, the heat which the iron loses in a certain time, is as the whole heat of the iron; and therefore, if equal times of cooling be taken

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the degrees of heat will be in geometrical proportion, and therefore easily found by the table of logarithms; first it was found by the thermometer with linseed oil, that if, when it was placed in melted snow, the oil possessed the space of 1000 parts; the same oil rarified with the heat of the first degree, or that of a human body possessed the space of 10256 parts; with the heat of water, just beginning to boil, the space of 10705; with that of water strongly boiling, the space of 10725 parts; with that of melted tin beginning to cool, and to be of the consistence of an *Amalgama*, the space of 11516; and when it is quite hardened the space of 11496; therefore, the rarified oil was to the same expanded by the heat of the human body, as 40 is to 39; by that of boiling water, as 15 to 14; by that of tin beginning to cool, coagulate, and harden, as 15 to 13; and by the heat of cooling tin when quite hardened, as 23 is to 20; the rarefaction of air by an equal heat was ten times greater than that of oil, and the rarefaction of oil was fifteen times greater than that of spirits of wine; from these *Data* putting the degrees of the heat of the oil proportional to its rarefaction, and taking 12 parts for the heat of the human body, you then have the degree of the heat of water when it begins to boil, viz. 33 parts, and when it boils more vehemently 34; of tin when melted, or when it begins in cooling to harden, and have the consistence of an *Amalgama*, 72 parts, and in cooling is quite hard, 70 parts.

Having discovered these things, in order to investigate the rest, there was heated a pretty thick piece of iron red hot, which was taken out of the fire with a pair of pinchers, which were also red hot, and laid in a cold place, where the wind blew continually upon it, and putting thereon particles of divers metals and other fusible bodies, the time of its cooling was marked, till all the particles were hardened, and the heat of the iron was equal to the heat of the human body; then supposing that the excess of the degrees of the heat of the iron, and the particles above the heat of the atmosphere found by the thermometer, were in geometrical progression, when the times are in an arithmetical progression, then the several degrees of heat were discovered; the iron was laid not in a calm air, but in a wind that blew uniformly upon it, that the air heated by the iron might be always carried off by the wind, and the cold air succeed it alternately; for thus equal parts of air were heated in equal times, and received a degree of heat proportional to the heat of the iron; the several degrees of heat thus found had the same ratio amongst themselves with those found by the thermometer; and therefore, the rarefac-

tions of the oil were properly assumed proportional to its degrees of heat.

The Death-watch; by Mr. Wm. Derham. Phil. Transf. N° 271. p. 832.

OF these death-watches, or insects, which make a noise like the beats of a watch, Mr. *Derham* observed two sorts; of which there is a very exact and true account *Phil. Transf. N° 245.* the insect there described being less shy, and much bigger than that he discovered some years ago; Mr. *Derham* had caught several of them, two of which, a male and a female, he kept alive in a little box about three weeks, and could make one of them beat, when he pleased, by imitating its beating; at last one died, and the other gnawed its way out thro' the side of the box: The reason why Mr. *Derham* judges, that these are male and female, is, because he has often by his ticking noise invited the male to get upon the other in the way of coition; that which he took to be the male was somewhat smaller than the other, and freest in answering his beats; before he got upon the other, he would beat very eagerly; and when he found that he was got up in vain, he would get off, and beat again eagerly, and then up again; from whence Mr. *Derham* conjectures, that these pulsations is the way these insects wooe each other, and invite to copulation; this Mr. *Allen* takes no notice of in his account; from which Mr. *Derham* differs, only concerning the part, with which the ticking noise is made, which Mr. *Allen* says is the extreme edge of the face; which may be called the upper lip; but Mr. *Derham* observed, that the insect always drew back its mouth, and beat with its forehead.

The other death-watch is an insect, in appearance quite different from the last; it beats only about seven or eight strokes at a time, and quicker; but this will beat some hours together, without intermission, and its strokes are slower, and like the beats of a watch; Mr. *Derham* had for several years observed these two sorts of beatings, but he took it to be made by one and the same animal: The insect which makes this long beating, is a small, greyish animal, much resembling a louse, when looked on with the naked eye; for which reason, he calls it *pediculus pulsatorius*; it is very nimble in running to seek shelter when disturbed; it is very common in all parts of the house, in the summer-months; they are extremely shy of beating, when disturbed, but will beat freely enough before you, and also answer you; when you beat, if you can view them without giving any distur-

disturbance, or shaking the place where they lie, &c. Mr. *Derham* cannot tell whether they beat in any other thing, but he has heard their noise only in, or near paper: Concerning their noise, he has some doubt, whether it be made by beating their heads, or rather their snouts against the paper; or whether it be not made after some such manner as grass-hoppers and crickets; Mr. *Derham* rather inclines to the former opinion; but his reason for doubting, is, because he had observed the animals body shake, or give a sudden jirk at every stroke, but could scarcely perceive any part of its body touch the paper; it is possible it might beat the paper, and he not perceive it, by reason its body is small, and near the paper when it beats, and its motion in beating is sudden, and swift; for which reason also, it is hard to perceive the insect beat, without a very quick eye; and therefore he made use of a convex-glass, which by magnifying gave him a much better opportunity of observing it: This ticking noise, Mr. *Derham* judges to be a wooing act, by reason he observed another, after much beating, come and make offers to the beating insect, who left off his beating, and got upon the back of the other; after they had conjoined, he got off again, and they continued some hours joined tail to tail, like dog and bitch in coition; the female he saw was somewhat bigger than the male, and of a lighter colour, inclining to a yellow, but whether all are so, Mr. *Derham* could not say; formerly, he had often pursued this noise but he thought himself disappointed, when he found nothing but some of these *Pediculi*, which he did not perceive to beat, and which he little imagined could have made so sonorous a noise, as he had heard some of them make, even as loud almost, as the strongest beats of a pocket-watch; but finding a piece of paper, in which he was sure the beating was, and happening to be loosely folded up, so as to be viewed throughout, and also lying in a good light, Mr. *Derham* viewed it narrowly, but he could only see some of those *Pediculi*, and observing them with a convex-glass, he soon perceived some of them beat, or make a noise, with a sudden shake of their body, as has been described; and he was so used to it, as to be able to see and shew their beating, almost when he pleased, by having a paper with some of them conveniently placed therein, and by imitating their pulsation, which they will readily answer; whether this insect changes its shape, and becomes any other animal, Mr. *Derham* could not tell, but he has some (tho' very little) reason to suspect that it becomes a sort of fly.

The Human Allantois discover'd; by Dr. Rob. Hale.
Phil. Trans. N^o 271. p. 835.

MOST of the ancients allow a human *Allantois*, not from their experience, but because they took it for granted, that man, and other animals were alike in the *Viscera*, membranes, vessels, &c. and the accounts they have left of many parts, particularly of the *Urachus* and *Allantois*, as to their name, figure, site, &c. agree only to their appearance in brutes: Dr. *Needham* first discover'd part of the *Allantois* in human subjects; but neither he, nor any other anatomist, have taken the right method of finding it entire; he says, that after the *Amnios* is cleared, and left fixed to the umbilical rope, you may divide by the fingers, or a knife, the remaining part of the *Involucra* into two membranes; the exterior he justly calls the *Chorion*, the interior he takes to be the *Allantois*; but by these ways of separation, you will presently tear the *Allantois*, and be able to discern only some small pieces of it; besides, the *Allantois* is at first sight so like the *Amnios*, that several who suppose the *Amnios* double, and that its coats are easily separable, have taken these pieces of the *Allantois*, for broken parts of one of the coats of the *Amnios*; whereas, having first found the *Foramen*, whence the urine is discharged, (if the *Allantois* is not too much torn) you may blow up the *Allantois* with a blow-pipe to its full dimensions, and then see its true shape, the *Fundus*, the *Cervix*, the insertion there of the *Urachus*, and its relation there to the other membranes, &c. let the *Allantois* be never so much torn, yet this way you may easily separate several inches of it from the *Chorion* and *Amnios*; which easy separation demonstrates a distinction of membranes, since no double membrane can be divided by the breath alone: Indeed *Hoboken* and *Diemerbroeck* make it a very easy thing to separate the *Allantois* from the other membranes, only by the fingers; but it is plain from their descriptions, that they never saw one entire; amongst other mistakes, *Diemerbroeck* says, that the urine of a *Fœtus* lies between the urinary membrane, and the *Chorion*, and tho' not contained in a distinct bladder, yet it was found in a cavity made partly from the *Chorion*, and partly from the urinary membrane: It is true, *De Graef* tells us, that by blowing with a blow-pipe into a hole made thro' the *Chorion*, all the membranes of the *Secundines* will appear distinct; he has also delineated an *Allantois*, with the other mem-

membranes, &c. as he says he found them; yet this figure must have been drawn from his own fancy, and not from any preparation; and that for these reasons, 1. Because by this way of separation, you can only part the *Allantois* from the *Chorion*, but never see its true dimensions, nor any appearance of a bladder; for a bladder, as the *Allantois* is, can be shew'd only by blowing into its cavity, or by finding it full; yet in this figure no sign can be observ'd where it was blown up, and tied; nor can this *Allantois* be supposed full of urine, because it is not of the shape of a full *Allantois*; and he himself calls it, only the inflated part of the *Allantois*; however Dr. Hale cannot conceive how the *Allantois* could remain partly filled with air, (any more than it might with urine) unless some hole was tied up, whence the urine was discharged, and the air blown in. 2. Because in this figure the umbilical rope seems to run thro' both *Amnios*, and the *Allantois*, to its insertion on the *Placenta*; whereas, the *Allantois* is no where perforated by the umbilical rope, nor does it any where pass thro' the *Amnios*, but only runs under it, at the place of its insertion on the *Placenta*; if the navel-string could be allowed to enter the *Amnios*, and pass under it to the *Placenta*, why should it not appear (which it does not) under the *Amnios*, as well as the thin substance of the *Allantois*? Again, as to De Graef's position of the *Secundines*, nothing could hinder a plain view of the place, where the navel-string is set on to the *Placenta*; this will easily be apprehended, by supposing the part H in Plate II. Fig. 1. to lie uppermost, the *Fundus* G, and navel-strings being turn'd over; for then the strings will run over the *Allantois*, as in De Graef's gut, and its insertion will appear plain on the *Placenta*, which yet cannot be discovered in his figure, which is altogether irregular, and Dr. Hale takes it to be fictitious; as for the urinary membrane G in De Graef's figure, it seems to be the *Allantois* of a colt, (where Needham says, the umbilical rope runs thro' the urinary membrane) not less absurdly added to the *Secundines* of a human *Fœtus*, than the *Secundines* of a whelp are ascribed to a like *Fœtus* by Vesalius.

Needham's description of this membrane is false in several particulars; for, 1. The urinary membrane does not cover the whole *Fœtus*, as he affirms, but only that part of it which respects the *Chorion*, and does not lie on the *Placenta*; for the *Allantois* can be extended at farthest but to the edges of the *Placenta*, where the *Amnios* and *Chorion* are so closely joined by

by fibres, that no membrane can come between them; wherefore, 2. The *Allantois* is not every where fasten'd to the *Chorion*; and consequently, 3. The *Allantois* cannot be of the same shape with the other membranes, nor resemble the *Allantois* of a colt, which contains the *Fœtus* in the *Amnios*, all which, *Needham* asserts; in short, he saw only some pieces of the urinary membrane, but never an entire one, and so he could only guess at the shape, &c. thereof, from what he had observed in mares, and glanduliferous animals; he might have made a better guess at the figure, site, &c. of a human *Allantois*, from that of a whelp, which does not every where inclose the *Fœtus*, as he observes.

Bidloo, in most of the figures of the *Secundines*, marks some vestiges of the urinary membrane; but in any of these figures, are only to be seen broken pieces of one, placed so confusedly, that no idea of its bigness, shape, or situation can be form'd therefrom; *Dr. Hale* owns, that the membranes of the *Secundines* are oftentimes so torn, that no art can exhibit an entire *Allantois*; however, among the many *Secundines* that have come under the hands of anatomists, several, no doubt, must have been entire enough for a fuller discovery, than they have made, had it not been for their ways of proceeding, viz. by knife, fingers, or blowing under the *Chorion*, impossible to discover any thing plain or satisfactory, even in the fairest subjects: The difficulty of finding this membrane, is by no means an argument against its existence; but a woman that dies big with child, is so fair a subject for the discovery of three membranes, that *Dr. Hale* wonders *Parey*, having such an opportunity, could find but two; *Dr. Tyson* observed three membranes in a like subject; and after the *Chorion* was divided and laid aside, he saw two bladders, containing liquors of different colours; which, upon pressing one towards the other, did not mix, but remain'd distinct, this observation fully satisfied that anatomist, as to the existence of an *Allantois*; and its figure, texture, site, &c. might also have been discovered by him, had not the less curious spectators been impatient to pass on to other parts of the dissection: Some deny an urinary membrane to a human *Fœtus*, because they suppose that the *Urachus* is impervious, and that therefore there would be no passage for the urine, consequently no need of an *Allantois*; *Needham* indeed says, that he could never find any sign of a cavity in the *Urachus*; yet was of opinion, that by blowing from the bladder, the air might be forced thro' a human

Ura-

Urachus, as easily, as he has often done it thro' that of a whelp; Dr. *Hale* cannot understand, why Dr. *Needham*, and others, should insist so much upon an apparent cavity in the *Urachus*, or expect that air should necessarily pass thro' it upon blowing, or think that otherwise it cannot be fit for the assigned office; since several bodies, as membranes, &c. will not admit air, &c. yet let water pass freely through them; it will not seem strange, that water should pass through the substance of the *Urachus*, if we consider that the cavity of the *Urachus* to the navel is open, as appears by inflation, or injections (not to mention any thing of those who are said to have made water by the navel) and that the rest of the *Urachus* is pervious, tho' not plainly hollow (the urine rather soaking gently, than running through its more streight tubes) may be gather'd from hence. 1. That the substance of the *Urachus*, as well as the cavity of the *Allantois*, is always found turgid with a liquor, that in colour, taste, and smell, seems to be urinous. 2. That since the mucous coat of the intestines is demonstrated to be vascular by M. *Leewenhoeck*, therefore, the mucous substance of the *Urachus* may also be vascular. 3. That urine may as easily ouze through these mucous vessels, as other fluids run through vascular cartilages and bones, &c. or the chyle into the lacteals, whose orifices (as M. *Leewenhoeck* observes, will scarce admit particles so big, as the 1000000000 part of a grain of sand) the great cavity of the intestines being open at the same time; or as easily, as grosser parts of the *Semen* pass the tubes of the testicles, whose cavities are not more perceptible; Dr. *Hale* is very sure that the urine is more assisted in its motion by the *detrusor Urinae*, &c. than any of these fluids can be by the heart, or other muscles.

Others will not admit of an urinary membrane; imagining it would be useless; because, they think, that when the bladder is full, the urine must be discharged at its *Cervix*, and not at its *Fundus*, by the *Urachus*; but in answer to this, the urine can never pass through the *Cervix* and *Urethra*, unless the abdominal muscles contract, because we never void urine naturally, but by the help of these muscles, nothing less being able to force open the *Sphincter vesicae*; now it being more than probable, that these vessels never act before respiration, no urine can pass through the *Sphincter* before the child breathes; no reason can be given, why the abdominal muscles of a *Fœtus* should voluntarily contract; since neither the quantity, or quality of the urine can excite to such an action; for
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when the bladder is too full of urine, it will ouze through the lax spongy substance of the *Urachus*, being gently pressed by the *Detrusor* alone; there would arise several inconveniencies from the voluntary contraction of the abdominal muscles of a *Fœtus*, as voiding *Fæces* as well as urine, into the *Amnios*, which would be more prejudicial than sweat, &c. yet if we should suppose that the abdominal muscles of a *Fœtus* act, the urine will however pass where it can most easily, i. e. through the *Urachus*, which is partly open, and altogether of such a texture, as in no wise to hinder the passing of the urine; much less be able to resist a considerable force, as the *Sphincter vesicæ* can; besides, the *Urachus* is not only thus qualified for the admission of urine, but when the mother lies down, it is almost upon a level with the *Urethra*, and what has once pass'd the *Urachus*, cannot return by reason of the length, situation, and peculiar structure thereof; and the *Clausura pudendi* happening sometimes in both sexes, demonstrates, that then at least, the urine cannot pass through the *Urethra*.

Dionis not finding any *Allantois*, nor an *Urachus* plainly pervious, thinks there is no need of either, on another account; for he supposes, that the blood which serves for the nutrition of the *Fœtus*, is depurated from all excrement; but Dr. *Hale* cannot apprehend, what should make this portion of the blood and chyle freer from excrement, than the rest of the mass of blood; there is indeed no portion of it, which does not contain parts unfit for assimilation and nutrition; and *Dionis* would have been convinced of his mistake, had he ever open'd abortions of five months old, or upwards, their bladders being always full of urine; and some *Fæces* constantly in the intestines; it is difficult to determine, when this separation of urine first begins; but Dr. *Hale* is apt to think it much sooner, than is generally supposed; Plate II. Fig. 2. is the *Allantois* of a very small abortion, which the Dr. has still by him; since all the parts are perfectly formed before impregnation; not very long after impregnation they may begin to perform their offices; no doubt, they begin as soon as there is occasion for any separation, and a separation of urine is necessary, when the *Fœtus* is first nourished by the umbilical arteries.

The existence of an *Allantois* is denied by some who grant an *Urachus*, but will have it convey the urine between the *Amnios* and *Chorion*; *Diemberbroeck's* opinion is somewhat like this, only he would have the urine lodged between the urinary membrane and the *Chorion*: These men do not consider, that
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the urine in this case would get into the *Amnios*, as well as the *Succus nutritius* of the *Chorion*; such a nutritious juice of the *Chorion* is granted by the maintainers of the fore-cited opinions, as well as by those, who deny an *Allantois* entirely, or suppose it to have a different figure, &c. from what *Diemerbroeck* assigns it; the transfusion or filtration through the membranes of this juice seems most likely in mares and sows; for in a mare, the *Chorion* is not joined to the *Uterus*, till she is half gone, and in a sow it does not adhere to the *Uterus*, till near the end of her going with young; but it is most evident, that the urine of a human *Fœtus* is not contain'd between the *Chorion* and *Amnios*, nor between the *Chorion* and *Allantois*, from the close connection of these coats to one another; as also, from the observation of midwives, who often find a bladder of water, which they call a by-bladder, offering itself before the child, whereas the humour of the *Amnios* is little, and of the *Chorion* much less, and of another colour, &c. at the time of the birth; this by-water is taken notice of, as an argument for an *Allantois*, by Mr. Cowper.

Dr. *Harvey* will not allow an *Allantois* even to brutes, and fancies that the *Allantois* and the *Chorion* are the same membrane, having two names; the first from its shape, the other from its office, or number of vessels; yet it is plain from *Galen*, and all the ancients, that they meant two distinct membranes by the *Allantois* and *Chorion*: Dr. *Harvey* thinks, that a *Fœtus* does not void urine, but that the bladder contains it, till the time of birth; what was offer'd against *Dionis's* opinion, may serve for an answer to this also; because, it was impossible for this anatomist not to observe sometimes an urinary bladder, he has thought of ways to explain such *Phænomena* without granting an *Allantois*; he had seen in sheep, and dogs, as it were, a certain process between the umbilical arteries, full of urine, which process is no doubt the *Allantois*, though *Bartolin* calls it the *Urachus*; again, he thinks, what is called by others an *Allantois*, if it is not the *Chorion*, is some coat accidentally formed from a reduplication of the membranes; because, since every membrane is double, nature may at a pinch, lodge the urine between a duplicature; yet he does not tell us how his duplicature is to be filled, since he allows no *Urachus*; but, in short, this urinary bladder can be no duplicature of the other membranes, since in all animals it differs therefrom, as to figure, texture, and in having an *Urachus*, which no other membrane has; and since every

animal that has a bladder, must have a like necessity for a receptacle of urine till born, and since the *Urachus* also is ever alike inserted in the same species of animals, and the urinary bladder constantly the same, as to shape, texture, situation, &c. the *Urachus* and *Allantois*, with its by-water, can be no accidental or preternatural things.

Plate II. Fig. 3. represents the *Secundines* of twins, to shew the *Allantois*, and its relation to the other membranes, &c. after the parts were prepared and dried; A A A A part of the *Chorion* expanded; B B B a line expressing the edges of the *Placenta*; C C C the *Amnios*, which is united to D the *Allantois* at E E E the line of union; F the *Cervix* of the *Allantois*; G a *Foramen* at the *Fundus* of the *Allantois*, whence the urine proceeded, and where the *Allantois* was blown up; H part of that half of the *Allantois*, which lies under the line of union, and immediately cover'd the *Fœtus*, unless it is supposed that the *Amnios* is continued under the *Allantois*; I I two stiles, or probes, thrust under the *Amnios*, which support the *Allantois*, and keep open the aperture **** of the *Amnios*, whence the twins came forth; K part of the *Placenta*, with some blood-vessels injected; L L L L the arteries of the navel-string filled with red wax; M M the umbilical veins, filled with green wax; N a communicant artery, by means of which all the arteries of both navel-strings were filled at once, and the veins were filled by one injection in like manner; O a pin that keeps out the *Amnios*, where from the edge of the *Placenta* it runs partly to the line of union, or adhesion, and partly over the *Placenta*; P part of the *Chorion* at the edge of the *Placenta*, where it runs under the *Amnios* on the *Placenta*; Q a pin that by a thread helps to pull open the aperture of the *Amnios*; R R R the *Urachus*, lying between the arteries; a a a a fibres or vessels, which fasten the *Allantois* to the *Chorion*.

Fig. 4. exhibits a side view of the same preparation, that the insertion of the *Urachus* may be the better seen: Observe, that A, and all the same letters in these three figures, denote the same parts in every one; S shews the course of the *Urachus* R at F in pricked lines; T part of the *Amnios* raised from the edge of the *Placenta*, to discover the *Placenta* K and U; U that part of the *Allantois*, which is below the line of union, near its neck F.

Fig. 5. shews an entire *Allantois* of a very small abortion, which *Allantois* was easily separated from the other membranes, between

between which it lay, and the *Amnios* remained an entire bladder, or membrane under the *Allantois*.

It is objected, that what is called the line of union can be no real thing; as to that, Dr. *Hale* does not know, whether the *Allantois* of twins may not require such a conjunction to sustain, and keep steady a greater quantity of urine; nor can he resolve, whether the *Allantois* of twins (like that of a single *Fœtus*, Fig. 6.) may not be distinct, and separable from the *Amnios*, which he could not discover; however, the reasons why such a line was figured, are these; 1. Although he used more force, with equal care, to separate the *Allantois* from the *Amnios* in this place, than in any other (where nevertheless the separation was very easy) yet he could not divide these membranes farther than that line. 2. This line seeming so regular, as to divide the *Allantois* into two equal parts, he could not take it to be the effect of chance, or of his separation. 3. The part H below the line E E was alike transparent with that part of the *Allantois* D above it; whereas had the *Amnios* been still joined to the *Allantois*, as the objection supposes, the *Allantois* below this line must have appeared thicker than that part above it, since the *Amnios* alone is much thicker, than the *Allantois*; it is easy indeed to conceive the *Amnios* running as an entire bladder, or membrane, under the *Allantois*, and perhaps the Dr. thought it might be so.

Others have taken this *Allantois* to be an *Amnios* of one of the twins belonging to these *Secundines*; this objection, though it may seem plausible, yet is of no force; for 1. This *Allantois* is much finer to the touch, and also much more transparent than the other *Amnios*, which still remains stiff; whilst the much thinner *Allantois* sinks upon the least blast of air, notwithstanding the stiles I I, which support it. 2. This *Allantois* had two visible *Urachi*, and it is of an oviform figure, somewhat resembling the common figure of a man's bladder; also this *Allantois* touches the *Placenta* no where, unless at the neck F; but on the contrary, the *Amnios* is of the same irregular figure, as the position, motion, &c. of the *Fœtus* require; likewise, it covers the whole internal surface of the *Placenta*. 3. They who make this objection must suppose some hole in this bladder, and in the *Amnios*, thro' which one umbilical rope may pass from the *Placenta* to the *Fœtus*; but such a *Foramen* would be preter-natural, because the navel-string runs only from the *Placenta* to the *Fœtus*, under a coat taken from the *Amnios*, and lies with the *Fœtus* in the cavity

of the *Amnios*, that is no where perforated. 4. The hole at the *Fundus G* was scarcely wide enough to receive the end of a man's finger, whereas the twins did not want six weeks of their full time; since therefore a *Fœtus* of near eight months could not possibly pass thro' this orifice, this bladder could not be an *Amnios*.

Nothing in these *Secundines* is preter-natural, only that some things were not observed before; hitherto, anatomists have not allowed twins to lie in a common *Amnios*, but supposed that each *Fœtus* had a distinct *Amnios*; the reason of this opinion might be, that some denying any urinary membrane, called every membrane they found, except the *Chorion*, an *Amnios*; and these finding two membranes in the *Secundines* of twins, supposed them to be two *Amnii*; that others granting an *Allantois*, but not distinctly discovering it, but only two membranes, also imagined them to be two *Amnii*; both these taking that for an *Amnios*, which might really be an *Allantois*; but since one *Chorion* and one *Placenta* (being ever of the same number) generally serve twins, nay, sometimes three *Fœtus*'s, why should it seem strange, that one *Amnios*, at least sometimes, and one *Allantois* should serve the like number?

Tho' *Mauriceau* and *Diemerbroeck* think there is an absolute necessity for every *Fœtus* to lie in a distinct *Amnios*, and that otherwise, twins in the same membrane would grow together, and make a monster; and *Aquapendens* further says, that all *Ova gemellifica* produce some other sort of monster; yet it is most certain, that *Ova gemellifica* exclude two perfect chickens, tho' not both alive: Dr. *Harvey* indeed thinks it possible, that such an *Ovum* may produce a monstrous chick, if its *Vitelli* are contain'd in the same membrane, &c. yet he does not positively say it must be so; but Dr. *Hale* cannot see any more reason, why twins in one *Amnios* should grow together, than that the hands or heels of the same *Fœtus* should grow to its own body; for how can the humours that lubricate a single *Fœtus*, and help it to move, join two together? Since the humours are the same, and the parts of the same *Fœtus*, as tender as those of twins are, and lie as close to one another, as twins do: It is very observable, that amongst all the monsters we read of, there are very few, which seem to be made of two entire bodies joined together, and that most of these upon dissection were found to have but one heart, one liver, &c. whence it is most evident, that these monsters, and no doubt all others, were

were originally monsters in the *Ova*, before impregnation, and not so for want of an *Amnios*; yet *Diemerbroeck* does not a little boast his having first, as he thinks, found the reason, why twins must lie in distinct *Amnii*; but since the matter of fact (sometimes at least, as in these *Secundines*, where there was only one *Amnios*, and two regular *Fœtus*'s) is not true, his argument for a necessity of two *Amnii* for two *Fœtus*'s, will never prove valid, even where twins, and two *Amnii* are found; indeed any part may be made to grow to another, as is seen in the cure of hair-lips, &c. but then the fibres must be first broken before there can be any union: Now *Dr. Hale* cannot conceive, what should naturally break the fibres of the twins in the *Uterus*; but altho' it is evident from what has been said, that twins may lie distinct in the same *Amnios*, yet there must be as many *Urachi*, as *Fœtus*'s; in these *Secundines* *Dr. Hale* saw two running over the *Placenta*, to the neck of the *Allantois*, the *Urachus* passes under the *Amnios*, as the other umbilical vessels do, and runs from that part, where the umbilical rope is joined on to the *Placenta*, streight to the *Cervix* F; S describes the course of that *Urachus* marked R at F Fig. 4. the other *Urachus* lay about a quarter of an inch laterally beyond that marked R in the same figure; by two *Urachi* the Dr. means two long roundish bodies, of a depressed figure; they seemed as large as a common knitting needle, and were of a darker substance than the *Placenta* on which they lay; they appeared in every respect like that part of the navel string, which is allowed by all anatomists to be the *Urachus*, and in like manner shrunk in two or three days from a mucous substance to a mere membrane: These two are the only entire urinary membranes that the Dr. prepared; yet in the several *Secundines* that came to his hands, he always found three distinct membranes easily separable.

From hence we can better explain some phenomena; as voiding urine by the navel, and the breaking of waters from women half gone with child, and tell the consequences of such accidents; as also, better account for those waters and bladders midwives meet with, and direct them in their doubtful operations.

An extraordinary Periodical Hemorrhage in the Thumb; by Dr. Wm. Musgrave. Phil. Trans. N° 272. p. 864.

MR. H— servant to Mrs. Jennings of Burton in Somersetshire, had from his infancy to the 24th year of his age, a periodical hemorrhage in one of his thumbs; the time of the eruption was about the full of the moon, seldom more than a day before,

before, or after it; the orifice was on the right side of the nail of the left thumb; he had not known the blood to be less in weight at any one periodical discharge, than four ounces; and when he came to be 16 years of age, the quantity was then increased to half a pound at each eruption; the manner of the flux was also remarkable; for without any pain in his head, difficulty of breathing, or any signs of a plethora, or other symptoms, excepting only a stiffness on the outmost joint of the said left thumb; the blood used to spin out on a sudden, with a considerable force, in several little streams, and continue so to do, till the greater part of the quantity was discharged; under this discharge, however copious, he was strong, and vigorous to the age of 24, from his most early, and tender years: At the age of 24, finding this evacuation troublesome, and being uneasy under it, he seared with a hot iron the part which used to open, and give vent to the flux of blood; Dr. *Musgrave* saw the part, it was hard, and callous, about a quarter of an inch; the searing had stopped the hemorrhage for about twenty years: This stoppage was in its effects very dangerous, and of ill consequence; for within a quarter of a year after it, he fell into a spitting of blood, bringing up from his lungs vast quantities thereof; this new complaint, together with a cough attending it, reduced him very low, so that Dr. *Dyke* of *Somersetshire* took him to be very far gone in a consumption; but by frequent bleeding, &c. he freed him of this *Hæmoptoe*, yet did not give him the relief which was expected; for in a little time the patient fell into a most violent cholic, from no other occasion, that he could discover, than his late illness, putting on a new form, and the matter settling on the bowels; this cholic was in good measure overcome by purging medicines, but a disposition to it still remained, for he had ever since been often troubled with it, as also with a spitting of blood, on the least catching cold, or motion: He had ever since the stoppage of that first hemorrhage been weakly, sickly, of a fallow, faint look, much impaired as to health, in comparison to what he enjoyed during the time of its periodical returns; and this affords an argument, that when nature has chosen, and for some time exercised new and extraordinary methods of oeconomy, she seems to be as fond of their continuance, as at other times, and in her most regular state, she is of that, which is her most usual and ordinary course.

There is a further use to be made of this, and such like monthly hemorrhages in men, whether by the thumb, *per Penem*, or any other part of the body; for these evacuations being analo-

analogous to the *Menses* in women, confute the opinion of all such, as derive that discharge from a *Fermentum uterinum*; for how can we think that the *Menses* come from such a local ferment, when a discharge, in all respects equivalent thereto, takes place, where no such ferment is, or can be supposed.

Spiders, *their Way of killing their Prey, spinning their Webs, &c.* by M. Leewenhoeck. Phil. Trans. N^o 272. p. 867.

M. *Leewenhoeck* about the latter end of *February* caught a black spider, and viewing it with his microscopes, he observed that its body and legs were covered with a great number of hairs, that stood as thick as bristles on a hogs back; tho' the legs were very hairy, yet were they so clear, that he could easily perceive the circulation of the blood in several veins, which were not a hair's breadth distant from one another; and afterwards he saw other fine blood-vessels, that were not the tenth part of a hair's breadth distant from each other; with the strictest observation, he could not discover the course of the arterial blood, but he could see, even in the smallest of the legs, three vessels together that conveyed the blood directly to the heart: Notwithstanding, that this animal is esteemed a bloodless insect by the ancients, because they could discover no red matter in its body, when they killed, or crushed it to pieces; yet M. *Leewenhoeck* plainly perceived some particles of blood, which according to all appearance were spherical, circulating in a liquid matter; but these particles of blood were extremely small, in comparison of those globules discovered in larger animals, for M. *Leewenhoeck* saw a space of three hairs breadth in the veins, where no particles of blood circulated; and he also observed, that the blood was expelled with great swiftness: M. *Leewenhoeck* viewed this spider several times, and at last in *March* he could see the blood in one of the arteries, but could not discover where the circulation began.

M. *Leewenhoeck* often took up that sort of spiders, whose breech is larger and thicker than that of others, to see whether he could discover any circulation of the blood, but in vain; and to satisfy himself, whether they had any globules in their blood, he cut off one of the hinder legs of such a spider, and viewed the blood that run out, in which he found but a very few globules; but upon wounding it in the fore-part of the body, and observing the blood that flowed from thence, he discovered abundance of globules therein; and cutting off part of the leg of another

another spider, he found more globules there, tho' he could not perceive any circulation of the blood in the legs: M. *Leeuwenhoeck* had often seen a spider hanging down from the branch of a tree by a thread of his own making, and holding fast by one of his hinder legs, which has three particular claws, two of which are at the very extremity, and each claw is armed with several teeth like saws, that towards the joining with the foot grow narrower and closer together, and where the thread it has spun, may be close twisted, just as in a pulley, on which clock-makers put their lines to fasten the weight, which in the beginning is wide and large, but the longer it grows, the narrower it is.

Plate H. Fig. 7. A B C D E F represents a small part of the leg of a spider, B C D shew the two extreme claws, armed with teeth like saws; E the third that hath no teeth, which claw M. *Leeuwenhoeck* supposes the spider uses on several accounts; this is certain, that when the spider does not wind itself by its thread upwards, but runs along its web, then it takes hold of the spun thread with this third claw; the above-mentioned spider is provided with eight long, and two short legs, which last stand out on each side of the head, having such claws as are before-mentioned; moreover, M. *Leeuwenhoeck* discovered eight distinct eyes, two of which are on the top of the head, in order to see what passes above him; below these were two other eyes, to look straight forwards; on each side of the head were two more, close to each other; the two foremost to see, as M. *Leeuwenhoeck* supposes, what passed collaterally before him, and the two hindmost to see the same backwards.

Fig. 8. shews that part separated from the membrane or pelli-
cle it lay in; P Q the eyes that look upwards; K L those that look straight forwards; I M those that look sideways forward; H N those that look sideways backward; now that spiders eyes are immoveable, having no muscles belonging to them, it is easy to conceive how necessary eight eyes are in order to look round about, the more easily to catch its prey: M. *Leeuwenhoeck* found that the spider has two instruments or cases for its sting in the fore-part of the head, which, when it does not use, it places in great order under its eyes, and between its two short legs; these stings are crooked like a claw, and very much resemble those of scorpions, or *Indian Millepedes*; the stings of a spider have towards the extremity and on each side a little hole, from whence, according to all appearance, when it strikes its enemy, it ejects a liquid matter, we call poison.

Fig. 9. ABCDEF, &c. shews the two instruments that contain the stings; BC the sting as it is cased or laid up; HIK the sting extended, and ready to wound, C and I the small holes which go quite thro' in each sting, EFG the two rows of teeth, which serve for a case to the stings, these teeth are covered with hairs; CB is the sting when at rest; the two rows of teeth M. *Leeuwenhoeck* supposes are designed to hold the prey it has hunted, and struck with its sting, so fast that it cannot be wrested from it; when he put two or three of the largest sort of spiders in the glass, he observed that when they met, they never parted without an engagement, in which one has been sometimes wounded in such a manner, that its body, was wet with the blood spilt in the battle, and that it died soon after; M. *Leeuwenhoeck* always observed that the lesser fled from the greater, and when it happened that two of an equal size met together, neither retired, but held each other so fast with their stings, that one would remain dead without stirring once, and so wet with the blood it had lost, as if it had lain some time in water; M. *Leeuwenhoeck* had one spider that was wounded by his antagonist in the thickest part of the leg, from whence issued a drop of blood as big as a large grain of sand; not being able to use this wounded leg to run away from his enemy, he raised it up an end, and presently after the whole limb fell off from his body; and he observed, that when they are wounded in the breast, or upper part of their bodies, they always die: M. *Leeuwenhoeck* observed that the spider cannot fasten its thread to any place, unless he first presses with his breech upon it, which pressure causes a vast number of exceeding fine threads to issue out of its body; from whence may be concluded, that as soon as those threads come into the air they lose their viscosity or stickyness: When M. *Leeuwenhoeck* opened or dissected a spider in order to discover that viscous stringy matter, which he took to be the beginning of their web, he could not find it, being surprised how such a strong thread could in so short a time proceed out of such a moist body, strong enough to bear the weight of six spiders; and when he endeavoured to find out the manner, how they make their webs, one and the same thread seemed to consist sometimes but of a single thread, and sometimes of four, or five; but he could not see how the threads issued from the spider's body; M. *Leeuwenhoeck* afterwards took a spider, and laid it upon its back, so as that it could not stir, and he pulled out with a very fine pair of pincers a thread, which he could perceive sticking out of one of the working instruments, and at the same time he saw a great many

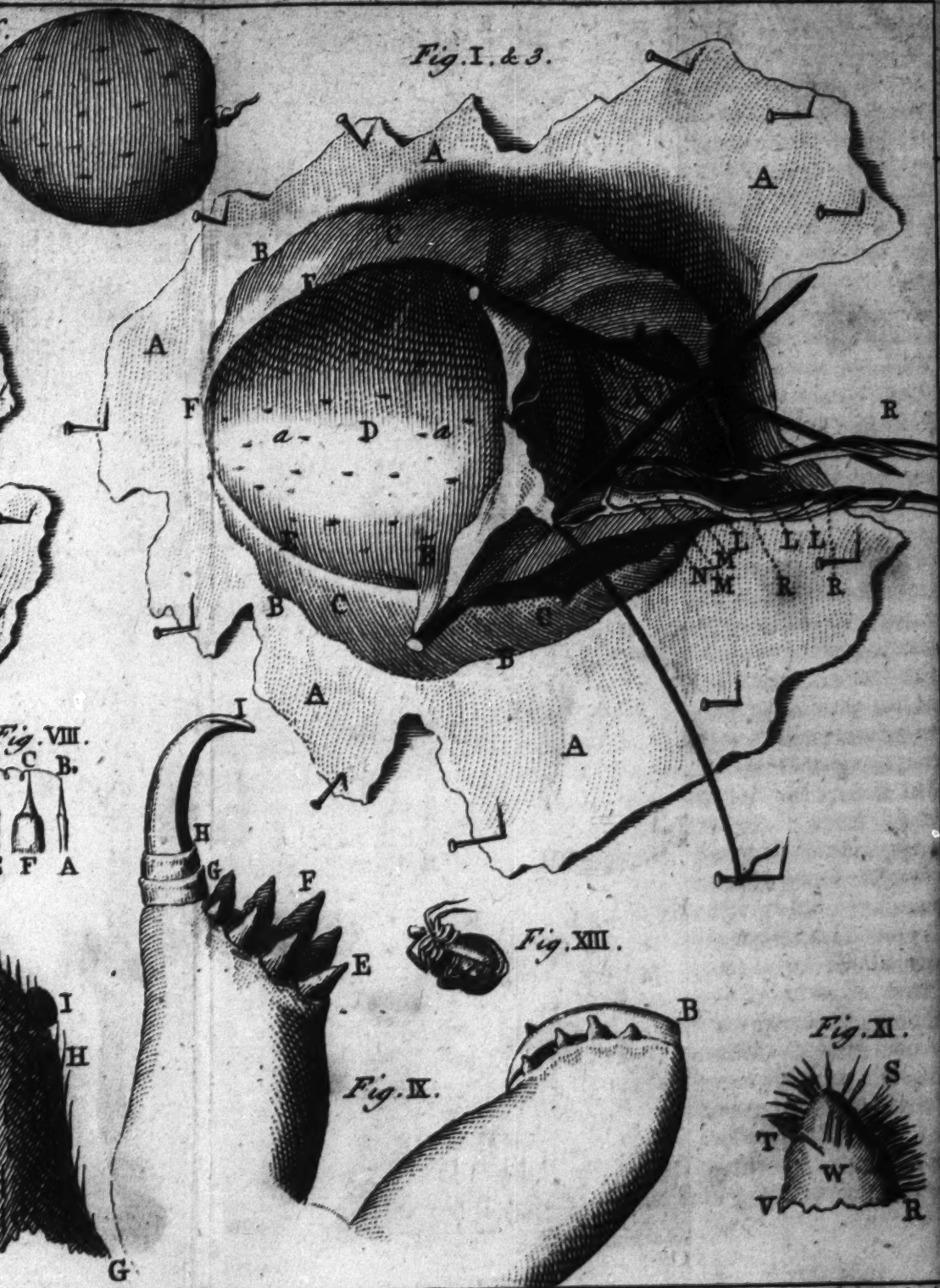
very fine threads issuing out of its body, which as soon as they were one or two hairs breadth distant from the body, were joined together and so made thick threads; *M. Leewenboeck* contrived to fasten these fine threads whilst they were divided, and just as they came out of the spider's body, which succeeded three several times, and the oftner the better; yet tho' he used his best glasses, those threads were so extremely fine, as almost to escape the sight; and in some places he found threads that were 25 times as thick as others that lay next them.

Fig. 10. MNOPQ represents a part of the threads, which came out of two of their working instruments, and are divided from each other, just as they issued from the body: Now, as we may perceive that a spider's web, which to the naked eye seems but single, does yet consist of several other threads, and thereby acquires a greater strength; we may from hence certainly conclude, that no flexible bodies (excepting metals, whose parts are strongly cemented by the force of fire) can attain to any degree of strength, unless they consist of long united parts, and the more these parts are twisted together, or cemented with any viscous matter, the stronger they are, which is very obvious in flax, silken thread, ropes, &c. and thus also hair and wool, according to its fineness has more or less strength, because each of those hairs consists of longer and finer parts, which are not only united together by a viscous matter, but are also armed with a skin or bark, which joins more closely the contained parts; now if we seriously reflect on the vast number of fine threads that at once proceed from the body of such a spider, we must own that it could not be otherwise; for to make a thread so thick and strong as is necessary in a spider's web, with the viscous matter thrown out of the animals body for that purpose, cannot be so soon done, nor be immediately congealed in the air, as the thin and fine threads, a 100 of which put together, will not, *M. Leewenboeck* thinks, make the 100th part of the thickness of one single hair of his head; in a word, we may hereby discover the wisdom of God in the perfection of his creatures.

M. Leewenboeck dissected the body of the largest spider he could find, and having investigated each part, he at last discovered the vast number of instruments, from whence each single thread proceeded, yea, the number was so great, that he judged them to be at least 400, but they did not lie hard by one another, but were divided into eight distinct parts or instruments, so that if the spider set all these eight to work at once, there would proceed eight particular threads, which were again subdivided

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divided into a great number of smaller; but one of the great threads was thicker than the other, because one part of the body would produce twice as many threads, as the other just by it; when M. *Leeuwenhoeck* viewed the dissected body with his microscope, and the place where the threads issued, he found they were shut up by five distinct parts, which are pointed at the extremity; but from the middlemost there proceeds no thread at all; the other four instruments, which shoot out these threads, are covered externally with thick hairs, so that all the small instruments lie inwards, for this reason (as M. *Leeuwenhoeck* supposes) that they may not receive any damage, when the spider creeps into any hole, where there is no occasion of making its web, or when it runs along the ground in quest of its prey; now, upon separating the above-mentioned four instruments, one shall find other four lying between them, which contain yet smaller and slenderer instruments, from each of which proceed exceeding fine threads; after those four instruments have been dissected in order to expose to view what lies internally, the scene is much the same with that of a large field, covered with a vast number of pointed twigs, and each delivering out a single thread; these instruments are double, and may be compared to a reed that is thicker at bottom, than a-top; out of which proceeded another, the biggest end whereof was incased within the smaller end of the former, and out of the smaller end of this last issued a thread of an exceeding fineness; it sometimes happened, that M. *Leeuwenhoeck* could not discover the working instruments in some of the above-mentioned parts, which he supposed, when the spider did not employ them in making its web, were shut up, and he could see nothing in the place where they were wont to proceed from, but their small points or tips, but with a little squeezing, they presently appeared in great numbers; he also observed, that some of those parts, from whence the threads proceeded were larger, and longer than the rest, which he supposed did produce threads of an extraordinary bigness, in comparison of the rest: Now, if we take it for granted, as is really true, that a young spider just came out of the egg is 300 times smaller than a full grown spider, and at the same time allow that this young spider has all the working instruments within its body, as the old one, (which, as it grows in bigness, are also enlarged in proportion) we must necessarily conclude that the threads spun by the young spider, are 300 times smaller than those spun by the old one, which fineness is scarcely conceivable.

M. *Leeuwenhoeck* always observed, that when the spider does not fasten its thread at one stretch, it is drawn inwards with bents and wrinkles, upon which he concluded, that each of those fine threads was round of itself, but by the addition of several other threads it acquired a flatness, as several common threads laid together appear to us; the same thing is also observed by gold wire-drawers, whose threads, if they break, or hang loose, wrinkle, and then always appear round.

Fig. 11. R S T U shews one of the four outermost instruments, with all its quills or reeds, which put together is not so large as a grain of common sand; from whence we may imagine how small those instruments must be, and how fine the threads are, incased within them; in the said figure at W the working instruments stood as thick by each other, as they do between R and S; moreover, that part from the sight was not covered with those sorts of quills, but with hairs only; the number of quills, upon twining this instrument about, was upwards of a 100; M. *Leeuwenhoeck* observed before, that a few of these instruments were larger than the rest, and consequently produced a larger thread; Fig. 12. A B and D E represent two small instruments that stood between two others, one of which had a wrinkled or harled thread; it sometimes happened when M. *Leeuwenhoeck* squeezed such an instrument as Fig. 12. instead of threads, there issued out matter that became a round drop, which he supposed was occasioned for want of a continuation of the same matter; whereas the other parts that stood next produced threads; when M. *Leeuwenhoeck* pressed the hinder part of the spider's body pretty hard with his tongs or pincers, it frequently happened that a round particle, the third part of an inch in length, and as thick as a horse hair, issued out, very transparent, and of a tough and viscous nature; which suggested to M. *Leeuwenhoeck*, whether this might not be the substance whereof the threads were formed, and also whether the body of the spider was not framed in such a manner, as to be able to press, or insinuate into its working instruments that matter, which was the foundation of the threads issuing from thence; he often cut off a piece of that part of the spider's body from whence these threads proceed, and he afterwards drew out long threads.

M. *Leeuwenhoeck*, at one time, took a very small frog, the length of whose body was about an inch and a half, which he put into a glass tube, together with a large spider, in order to see how they would behave; when he observed that the spider past by the frog without touching him, yet it exerted its stings,

as if it intended to have fallen directly upon the frog; afterwards M. *Leewenhoek* caused the frog to run against the spider, who thereupon struck it in the back with its stings, and wounded the frog in such a manner in two several places, that in one it left a red speck, and in the other a blue one; hereupon M. *Leewenhoek* brought them together again, when the spider struck its stings into the frog's fore-leg, who, upon that struggled so hard, that the spider was forced to leave it, and he observed that some few of the blood-vessels in the frog's legs were wounded; once more M. *Leewenhoek* forced the frog to juggle against the spider, who upon that struck both its stings into the frog's nose, after which they both stood still about half a minute, then opening the glass he took the spider out, whilst the frog lay still about an hour, and then stretched out its hinder legs, and died.

The next day M. *Leewenhoek* took another frog about the same size with the former, and another spider, and putting both into the same glass, the spider passed by the frog without meddling with it, but when M. *Leewenhoek* shook them suddenly together, the spider struck both its stings into the frog's back, but he could not perceive that it was wounded so far as the veins, for there was no blood spilt; this frog was very shy of the spider, and as soon as the spider came near it, or touched it with its feet or claws, the frog used its utmost efforts to avoid it; again, M. *Leewenhoek* brought the frog so near, as to touch the spider with the fore-part of its body, who thereupon gave it two blows with its stings in the lower part of the head, one of which pierced the blood-vessels, so that there remained a red spot; the spider quitted the frog presently, because of the strong efforts the other made to get rid of it, and then the spider set itself to cleanse its stings with a liquor that came from its mouth for that purpose; after that, M. *Leewenhoek* separated the spider from the frog, and viewing the circulation of the blood in the latter to see whether there was any alteration therein, occasioned by the wound received from the spider, but he could discover none, nor could he perceive that the frog had got any harm, for next day it was brisk, as if nothing had ailed it: Now, it is possible that the stinging of spiders in hotter countries may be more pernicious than in our climate; and it is also possible, that this spider might have lately spent its poison, by wounding another spider, or some other animal; when M. *Leewenhoek* had kept this frog four days in the glass tube, and found that he was never the worse for the stinging of the spider, he flung it into the water, and
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observed that it endeavoured to swim towards land, as all frogs do in deep waters, for fear of being devoured by the fish.

M. *Leeuwenboeck* observed the blood of a spider, and found that every particle of blood consisted of several other smaller ones, each of which he supposed was composed of six others, analogous to the blood of the human body, and moreover he observed several other, yet smaller particles, some of which were less than others; but these last particles were not visible, till the fine *Serum* of the blood was quite exhaled; moreover, in viewing the blood that issued from the feet that were cut off, M. *Leeuwenboeck* observed, if he look'd any time upon it, the *Serum* would exhale, and the salt particles would cleave together, like so many fine twigs or branches, resembling the night-dew when congealed on glass-windows; but when he forbore looking, and laid the glass by, the air being cool, the crystalliz'd salts returned to their former figure; and again, if he brought his warm hand but for half a minute near the glass, all the salt particles were coagulated again; but by breathing a little upon them, they were quickly reduced to a clear water; it was curious to see these salts, which seem'd to have their rise from a point, or exceeding small particle of blood, stream and branch themselves, as it were, into trees: Afterwards, M. *Leeuwenboeck* took up another spider, and put it into a glass-tube, in order to discover the circulation of the blood, which he saw very plain, both in the veins and arteries; and its legs being very transparent, like those spiders found on trees or shrubs, he saw several times a sudden and brisker motion of the blood, which he supposed might be occasioned by every systole and diastole of the heart: M. *Leeuwenboeck* took another spider he found on a thistle, which was eight times smaller than the large garden one, and easily perceived the circulation of the blood both in the veins and arteries: In the middle, or about the latter end of *October*, M. *Leeuwenboeck* took several of the largest spiders he could find, and shut them up severally in glass-tubes, in order to lay their eggs, and to see what he could discover in the said eggs; he found in their excrements the entire wings, heads, and legs of small flies, which were so large, that he could not conceive how they pass'd thro' their bodies; on the 30th of *October*, he observed that two of the spiders had laid eggs, and had in a few hours covered them with a vast quantity of their web; which he took, and the eggs inclosed therein, and opening several of them, he found they were of a yellowish colour; these eggs were almost round,

round, and the axis of one of them was about the 30th part of an inch, and when they lay altogether, they made a roundish body, whose axis was half an inch; but if you look'd sideways upon them, their diameter appeared to be the fourth part of an inch; from whence it is very easy to calculate what a vast number of eggs one spider will lay: Upon a narrow view of this large heap of eggs that lay in order by each other, one would be apt to judge it impossible for such a number to proceed from the body of one spider; but the wonder will cease, when we consider, that the eggs are not exactly round, while they lie in the spider's body, but being pressed together, they assume particular figures; these eggs being round, lying in order, and touching each other but in one point, must needs take up more room, than when they lay in the spider's belly; the membrane, or shell, of these eggs is very weak, so that in endeavouring to separate them, because they stick to each other by a viscous matter, M. *Leeuwenhoek* could not help oftentimes breaking them.

On the last of *October*, about five in the evening, M. *Leeuwenhoek* observed, that another spider had made its web against the sides of the glass-tube, in order to lodge its eggs there; and whereas, before he could not imagine how the spider had placed its eggs in the middle of the glass, he was now fully satisfied on that matter, for he plainly saw that the spider made its web like a thick bed against the glass, that as yet there were no eggs in it; and what was most remarkable was, that this bed was not flat, but had a well contrived hollowness within, not exactly round, but oval; about 40 minutes after, viewing the spider again, found that the said bed was not only full of eggs, but that there was a large heap of them standing above the bed, and the spider very busy in covering them on every side with its web, using its two hinder feet, as well as its breech to fasten the threads that proceeded from thence, and to range them all in order; all the spider's working instruments were open, and all of them seemed to deliver out thread for the work; sometimes the spider raised up its body a straw's breadth, and then removed it as much, that the threads might have a freer passage the better to cover the eggs; when the spider had laid all its eggs, its body was not the fourth part so large as before, and tho' lately smooth and distended, it was now full of wrinkles and cavities; on the 30th of *October*, M. *Leeuwenhoek* carried some of the eggs in a glass-tube about him, to see whether the heat of his body could hatch the young spiders, which usually come out of their eggs in spring; but at last the moisture was all exhausted, and no
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young ones hatched; from which experiment M. *Leeuwenhoeck* concluded, that these eggs had not been impregnated by the male, as also, that all spiders, which in the latter part of the year have large bodies, are full of eggs; on the 7th of November, he saw six or eight eggs laid, which did not come out of the hindmost part of the body, as in all other animals, but from the upper part of the belly, not far from its hinder legs, where grows a sort of a hook of a particular figure, which comes partly over the aperture, from whence the eggs issue; but in order to be fully satisfied in this matter, M. *Leeuwenhoeck* took several spiders that had not yet laid their eggs, and laying them on their backs, he pressed their bellies, whereby he not only had a clear view of the aperture, but by squeezing a little harder, he forced out several eggs, but there did not proceed the least moisture from the hinder part of the body; this experiment convinced him, that that was the place from whence the spider discharg'd both her eggs and excrements.

Plate II. Fig. 13. A B C represents a spider of an ordinary size, as it lay on its back, with the legs contracted, as if it was dead, in order to shew the above-mentioned aperture; D the hook.

Fig. 14. G H I K shews the hook separated from the spider's body, as it appeared thro' the microscope; between I and K are seen the wrinkles or folds, which M. *Leeuwenhoeck* imagined were made to produce a more than ordinary motion; E F shews the part that joined it to the body; and he does not know, whether the foresaid hook might not be designed to range the eggs in order; in the said Fig. 14. between F and G are two round balls, but he could not imagine their use.

January 1st, was the third time M. *Leeuwenhoeck* took a spider's eggs, and putting them into a glass-tube, he carried them about him; the eggs were laid by the largest spider he had seen last summer, and it was one of the last he could meet with in the gardens; he viewed them several days without opening, and finding no alteration, which he attributed to the cold weather, he did not look upon them for four days, but upon the 17th of the same month, in the morning, viewing them again, he saw 23 young spiders that came out of 50 many eggs; and about 25 more, whose bodies were but half out of the egg-shell, and some of them had their shells hanging on their tail; and in the evening, about 6 o'clock, he reckon'd 150 young ones; the next day he viewed them again, when he concluded that no more spiders would come out of the eggs, and that several which he

he saw lying about the glass were barren, and that in others, the young spiders were dead, the number of which he reckon'd was about 50, and about 10 or 12 eggs were blackish; when the glass-tube, where the young spiders were, had lain out of his pocket but 15 minutes, in very cold weather, he could hardly discover any life or motion in some of them; but as soon as the glass was warm'd a little, they were brisk and lively, and most of them got together like swarms of bees, and so hung about the web, where the eggs had been lodged before.

On the 21st of *January*, he could perceive the eight eyes in every spider, which before were not so visible; but being now of a brown, or darkish colour, they were easily distinguishable from the fore-part of their body, which was white, as the hinder part was yellowish: Now, if we consider, what a vast number of spiders are produced by one, and in how short a time, we cannot conceive whence, or how, they get their food, especially since the old ones, as far as *M. Leewenhoeck* could see, fed upon nothing but animals; on the 22d of *January*, he observed that the legs of several spiders, which had been before clear and transparent, did now assume a dark colour, and afterwards began to be covered with hair, whereas he could perceive none a little before; on the 23d, their legs grew darker, and so did the hinder part of their bodies, whence their web proceeds, which also began to be covered with hairs; then he observed, several particles of a watery matter hanging on the sides of the glass, which he had never before taken any notice of; but now there was so much of it, that the barren eggs, which before rolled freely about the glass, were glewed on to it by this viscous matter, which so much abounded, that the young spiders had much ado to pass thro' it; he likewise observed, that they had cast their very thin skins, and began to be much nimbler in their motions; the 25th, he saw them spin a thread, and manage it with their hinder feet, as well as the old ones; he observed that they had eat up the barren eggs, and the others, wherein *M. Leewenhoeck* supposed the young ones were dead, to the number of 50; for a few days after there remain'd nothing, but the bare shells.

M. Leewenhoeck compared the threads of a full-grown spider with a hair of his beard, the thickest part whereof he placed before the microscope, and according to the nicest observation, he judg'd that above 100 of those threads laid together, did not equal the diameter of a hair of his beard; now supposing this hair to be round, 10000 of the fine threads of a spider's web, are not thicker than a single hair of a man's head; now if we add to this,

this, as it is most certainly true, that 400 young spiders, when they first begin to spin, are not, one with another, bigger than a full-grown one, and that each of those young spiders is provided with all the working instruments, as the old one, it would follow, that the smallest thread of such a young spider is 400 times smaller than that of a great one; and if so, then 4000000 threads of a young spider are not so big as a hair of a man's head; but then again, if we consider of how many parts one of those smallest threads consists, we must stand astonished: M. *Leewenhoeck* observed, that half the young spiders were smaller in the hinder part of their bodies than the rest, which last he supposed to be males; as also, that most of these young spiders had bored into the web, and in a manner lodged themselves therein; which made M. *Leewenhoeck* suspect, that for want of other food they had fed on the web; and the rather because, some of them were grown pretty big; on the 30th of *January* most of them were employed in weaving their web, so that the glass swarm'd with them; on the 8th of *February*, M. *Leewenhoeck* could perceive that several of the spiders had eat one another up, and at the very time he look'd upon them, there were four that had almost devour'd one, and here and there, he saw pieces of legs, and at last the shells of the barren eggs were so plainly eat up, that he could see nothing remaining of them: On the 10th of *February*, M. *Leewenhoeck's* spiders were reduced to half their number, and such as remained were eating the thickest of their companion's legs; these spiders diminished daily; so, that on the last of the said month, he could see but 30 of them alive; among which a few were 20 times as big as some of the rest; on the 5th of *March*, M. *Leewenhoeck* could see but three or four alive, and about the web he observed a black matter, about which the spiders swarm'd very much; and he found that it was nothing else, but a heap of legs of such young spiders as had been devoured: M. *Leewenhoeck* kept by him the eggs of several spiders in glass-tubes, and particularly on the 24th of *January* he put the eggs of two different spiders into two distinct glasses, and on the 6th of *February* he could perceive in one of them three young spiders crawling out of the web; he took one, whose egg-shell still hung at its tail, and set it before his microscope in the open air, and tho' the fore-part of its body was as clear as glass, yet he could not perceive the least motion in the inner parts; from whence he concluded, that the heart was not in their breast, for had it been there, he must needs have

perceived its motion; therefore, he believ'd it lay near the eyes, where it was not so transparent; for that the expulsion of the blood in a spider proceeds from the heart, is, he thinks, not to be doubted: M. *Leewenhoeck* endeavour'd to discover the circulation of the blood in the legs of these little animals, which observation succeeded with him several times; when he cast his eyes upon the hinder part of their bodies, he could perceive, that their intrails consisted of a vast many globules of several sizes, of which the eggs are composed; on the 7th of *February*, M. *Leewenhoeck* could not perceive that there were any more young spiders come out of the web, but he saw at least 25 egg-shells lying without the web; on the 9th of the said month a few young spiders were come out of the web, that had cast their skins, and others were crowded together in the web; on the 10th, all the young spiders had got out, and shed their pellicles, before which time M. *Leewenhoeck* did not believe they endeavour'd to come out; on the 12th of *February* he laid one of the glass-tubes upon his desk, to see how the spiders would fare in cold weather, and next morning he found that most of them were crept into their web; but after he had carried them some hours in his pocket, he found that they were come abroad again; the 20th, he took two young spiders out of the said glass-tube, and putting them into another that was thinner, he stopped both ends with paper, so that they might not get out, and yet have air enough; the 14th of *April*, he perceived that one of the spiders lay dead, and the other was very well and lively; but on the 26th, it began to flag in its motion, and next day it was also dead, and yet he could not see that the one had hurt the other; whereupon, he concluded, that these young spiders will live more than two months, if it be cold weather without eating.

In the great glass-tube, from whence M. *Leewenhoeck* had taken the above-mentioned two spiders that had been hatched at the same time, there were still (it being then the 26th of *April*) 20 young spiders alive, sitting altogether on the web, which they had spun, without once touching, or running about the glass, because, as M. *Leewenhoeck* supposed, the glass was too cold for them; and on the 22d of *May*, there were but three of them living, which he could not perceive grown much bigger; the rest lay by as dead, but mostly devoured by the longest livers; the young spiders in the second glass tube, which M. *Leewenhoeck* carried about him a long time, did not live near so long as the others, the reason whereof was, as

M. *Leewenboeck* thinks, that the warmth of his body caused them to perspire the more, and consequently, made them stand in need of their food the sooner: He had the eggs of six several spiders, which he often viewed, to know when the young spiders would come out; and on the 20th of *May*, he observed, the eggs change colour a little; and on the 22d, the young ones were hatched, and lay so close to one another in the web, that they took up but little more room, than when they were in their shells; and M. *Leewenboeck* could not discover any motion in them, only such, as lay outermost, moved their legs a little; when M. *Leewenboeck* took the fleshy muscles out of their legs, and view'd them thro' a microscope, they were very transparent, and they seemed to be one body; but when he came to separate them, he found that they were composed of very long particles, each consisting of so many *Rugæ* or folds, that the muscle could be either dilated or contracted, as occasion required.

Strange Bones dug up near Canterbury, and of the Isthmus that joined France and Britain; by Mr. John Somner. Phil. Transf. N^o 272. p. 882.

MR. *John Somner*, in September 1668, sinking for a well at a new house of his at *Chartham*, a village about three miles from *Canterbury*, towards *Ashford*, on a shelving ground, or bank-side, within 12 roods of the river, running from thence to *Canterbury*, and so to *Sandwich-haven*; and after having dug for that purpose about 17 foot deep, thro' gravelly and chalky ground, and two foot into the springs, he turned up a parcel of strange and monstrous bones; some whole, and others broken, together with four teeth, sound and entire, but in a manner petrified; each tooth weighing somewhat above half a pound, and some of them almost as big as a man's fist; *Ludovicus Vives* mentions such a tooth, but a little bigger, which was shewn him for one of *St. Christopher's*, kept in a church that bore his name; just such another tooth was seen by *Acosta* in the *Indies*, dug out of the ground in one of their houses there, with several other bones, which put together represented a man of a formidable bigness; and so must we have judged of these teeth, and the body to which they belonged; had not other bones been found with them, which could not be human; some who had seen the teeth, and by some other circumstances, were of opinion, that they were the bones of a *Hippopotamus*, or sea-horse; the earth, or mould, about them, and

and wherein they lay, resembling a sea-earth, or fulling-earth, without a stone, unless you dig three foot deeper, and then it rises a perfect gravel.

Mr. *Somner* supposes it to have been some marine or sea-bred animal; but how then, will some say, should it possibly come there; and at such a depth under ground too? To which he answers. 1. With as little wonder as a land animal should come thither. 2. The mould, soil, or earth, wherein it lay, was altogether miry, resembling the ouse on several parts of the sea-coasts both in *England*, and abroad; but how can it possibly (may some say) be a sea-animal, when found at so remote a distance from the sea? For the solution of this and such like doubts, Mr. *Somner* branches out the argument into these four following queries:

1. Whether the situation, condition, face, and figure of the place may possibly admit of the sea's once insinuating itself thither?

2. Whether (that possibility being granted, or evinced) the sea did ever actually insinuate itself so far, as to reach this place, and when?

3. How, with any probability, and when, this valley or level, being once cover'd with sea, should come to be quite deserted and forsaken by it, as it is at this day; the sea not approaching it by 12 miles, or more?

4. By what means, the sea having once had its play there, this creature came to lodge, and be found so deep in the ground, and under such a shelving bank.

1. As to the first, *viz.* the aptitude of the place for the sea's influx or insinuation; such as know the situation, cannot but know and agree that it is so; for it is a part of that wide, fair, and fruitful level, or valley, extending itself no less than 20 miles in length, between a continued range of hills, downs, or high grounds, lying at a pretty distance from each other all the way; beginning at the east *Kentish* shore, and stretching westward by *Sandwich*, *Fordwich*, *Canterbury*, *Chartham*, *Chilham*, *Godmersham*, *Wye*, and *Ashford*, sometimes in a direct, sometimes in a winding course, as far as that famous spacious level of *Romney-marsh*; and is washed and watered all along, at least from about *Ashford*, by a pleasant river, running thro' the midst thereof, as far as to *Sandwich*, and there emptying itself into the sea, by the creek or haven; there is no obstruction at all, by the interposition of hills, or high ground, to controul the free play and passage of the sea for so many miles together.

If

If any will object that *Canterbury* lies in the way, as an obstruction or bar, the answer is easy; for altho' that city seems, and indeed is, at this day, for the most part somewhat elevated above the rest of the level or valley; yet not so much as to defend itself many times from floods in the lower, and most depressed parts thereof; even by the springs it stands upon, to its great damage and annoyance; towards helping of which, by the care of former ages, it is very certain, and as is daily experimented by digging wells, vaults, cellars, and the like, that the most part of this city, not excepting the very heart of it, is made and raised ground, the marks of foundations upon foundations, to a very considerable depth, appearing daily, and the ground, as at *Amsterdam*, *Venice* and elsewhere, for supporting superstructures, is in several places often stuck and stuffed with piles of wood, or long poles and stakes, as both well- and cellar-diggers have inform'd Mr. Somner; nay, and as if the river had sometimes had its course or current, where now the bull-stake market-place is kept, pits and other like tanners utensils have, not many years ago, been met withal in digging for cellars thereabouts; and moreover, Mr. Somner's next neighbour in *Castle-street*, within these 30 years, sinking a cellar, did five or six foot deep, light upon a strong and well-couch'd arch'd piece of *Roman* tile or brick, whereof Mr. Somner was an eye-witness; however then, *Canterbury* may now seem to stand in the way of the *Æstuary*; yet time was, when in all probability it did not; when, to wit, the soil which the city now occupies, as the rest of the whole valley both above and below it, was of too low a pitch, to be an obstacle to it.

2. As to the second enquiry, viz. whether probably the sea ever actually insinuated itself so far as this place, and when? The answer is not so easy, for we have no records of it; the best and oldest account we have of the condition, site and constitution of these our eastern parts we owe to *Julius Cæsar*, and the *Romans* after him; from whom we have not the least spark of light to such a discovery; rather indeed the contrary, both the sea coast, and in-land parts by their relation, bearing in a manner one and the same face and figure then as now; however, there are several *Criteria* or tokens that the level was sometimes an *Æstuary* or arm of the sea; for instance, besides what may be inferred from this parcel of teeth and bones now under consideration, there is, Mr. Somner thinks, much probability for it from the name of their river *Stoure*, very often of old called and written *Æstur*, or *Esture*, &c. which Mr. Somner does not doubt comes from the *Latin* *Æstuarium*, and was in process of time corrupted and con-

contracted into *Sture* and *Stoure*, giving name in part to *Stourmouth*-parish about six miles eastward from *Canterbury*, so called from the rivers disemboguing there into the sea flowing up thither; as also giving name to a manor of the Archbishop, that for some ages past, and to this day is called *West-gate Court*, at *Canterbury*, but more anciently, as in the Conqueror's time (witness *Domesday-book*) was called the manor of *Esture* and *Esturesate*, from its situation by the *Sture* or *Stoure*; from which likewise, without doubt the lord *Finch's* seat in — about five or six miles nearer the spring-head, now vulgarly called *East-steward*, was of old sometimes called *Esture*, at other times *Esture*.

As by the bones and teeth, now under consideration, we have an instance on that side of the valley for the probability of the sea's occupying it formerly, so Mr. *Somner* gives another from the opposite side; by credible relation a place called *Westbere*, an obscure village about three miles from *Canterbury*, eastwards, lying under the brow of the hill that stretches out by *Up-street* as far as to the west end of *Sar-wall*, by which you enter into *Thanet*, upon the like occasion as at *Chartham*, viz. digging a well, at a very great depth, there were turned up store of oysters and such like shells, together with an iron-anchor firm, and unimpaired; Mr. *Somner* had been likewise told of an anchor dug up at *Broomedowne*, on the same side of the level somewhat above *Canterbury*, westwards.

3. The third query is, how with any probability, and when this valley or level, being once sea-land, should come to be quite deserted and forsaken by the sea, as it is at this day, the sea not approaching it by 12 miles or more: In answer, Mr. *Somner* grants, that in case this level was once an arm of the sea, it was so very long ago, that we cannot reasonably think, that *Canterbury* (whether as a city, or as never so mean a village) was then a place inhabited, which perhaps it might have been, if not in *Julius Cæsar's* days, yet undoubtedly, not long after; for we have an account of it, as well as of other places in *Kent*, in the time of the *Romans*, both from *Ptolemy* the Geographer, *Antoninus's* Itinerary and elsewhere; and we have no elder records of *Britain*, that we may confide in as authentic, before the time of the *Romans*, to help us in this scrutiny; we must therefore, either throw off all further enquiry, or cast about for information as well as we can; such as are for the latter tell us, that the world being many thousand years old, manifold are the alterations, which time hath made in several parts; to the notice and discovery whereof,

whereof, no written records, or unwritten tradition at this day, can reach or direct us; of such a nature they conceive this of the *Æstuary* may be, so very ancient, that time hath quite wore out the memory thereof; and a parallel case with the present, is, that of the sea's breaking, bursting, and cleaving asunder that *Isthmus*, or neck of land, between *Gaul* and *Britain*, which made the latter of the same continent with the former; such things, it is certain, have happened elsewhere; thus, says *Seneca*, that the sea had rent *Spain* from *Afric*; as also, that *Sicily* was divided from *Italy* by *Deucalion's* flood; more instances of this kind are to be found in *Cambden's Cantium*, and elsewhere; and altho' there be no certain evidence of such an accident here, either from ancient historians, or geographers, yet the thing is so strongly and rationally argued, especially by *Cambden*, as also by *Verstegan*, *Twine*, and others before him; and the conjecture is backed with such plenty of probable *Criteria*, that *Mr. Somner* cannot but be of that opinion; especially, when he has added this one argument, omitted by *Cambden* and the rest; viz. that by a constant received tradition, that large and spacious level, *Romney-marsh*, containing, according to *Mr. Cambden*, 14 miles in length, and eight in breadth, was some time sea, lying wholly under salt-water; and is therefore, by some not improperly called the sea's gift; *Mr. Somner* thinks, if he can guess at the time, and occasion of the recovery of both that and *Canterbury-levels* from the sea, he shall pitch upon that of the sea's breaking thro', and in time washing away that *Isthmus* between *Dover* and *Calais*; and whereas formerly *Romney-level* (which had its *Stoures* or *Æstuarium* as well as ours) and this other, were but one and the same level, and lay under the sea, because no high lands, interpose to impede their conjunction; now both the one and the other (the sea having so much more play than formerly, by cleaving asunder the *Isthmus*) were recovered from it, and of an *Æstuary* became such a rich and noble level or valley, as is second to none in *England*; from hence *Mr. Somner* thinks, might be taken a hint to consider the *Netherlands* or low-countries, and enquire whether these in whole or in part, might not have arisen out of, and be conjecturally assign'd for our *Kentish* low-lands.

4. As to the fourth query; by what means the sea having once its play at *Chartham*, this creature comes to lie so deep in the ground, and under such a shelving bank? To this it may be answered, that supposing this with the rest of the level or valley to be once occupied by the sea, that being a creature, which by the flux and reflux is always in motion, and thereby in time beating

beating upon, and working itself into the bank, or rising ground, might at length so far undermine and loosen it, as to fetch down so much mould or earth over the place, as to lodge itself at so great a depth; or else perhaps, the continual agitation of the water might in time force, drive up, and cast over it, that great quantity of ouse, earth, and other matter, under which it lay; by the way, it is observed, that the nature of the soil, is so loose, supple, rotten, and sandy, that merely of itself, it is apt to sink, and fall in; as was lately experienced by a saw-pit dug hard by, which soon after, by the earth's giving way on each side thereof, fell in and filled it up.

Hydatides voided with the Urine; by Dr. Davies. Phil. Trans. N^o 273. p. 897.

A Gentlewoman between 40 and 50 years of age, drank some aluminous water for four or five weeks in autumn, and in a month's time after the use of these waters, she found a pain in the renal region, where she had never been afflicted with any before; this pain returned, after the first paroxysm, in about a month's time, and afterwards more frequently, till about the *Christmass* following; it visited her every day, about which time she sent for Dr. *Davies*; she had, when he came to her, the symptoms of a stone in her left kidney; *viz.* a grinding, and sometimes a very acute pain on that side of the *Spina dorsæ*, a vomiting, her urine during the paroxysm tinged with blood, and therein bloody *Ramenta*; but what was most surprising, was a dozen, at least, of *Hydatides*, some of the largest were an inch and a half long, and their circumference equalled that of an ordinary goose-quill; they exactly resembled the shape of the *Vesiculæ Natatoræ* in fish, becoming smaller about the middle, as those generally do; and were filled with a liquor, which, by its taste and smell, made the Dr. take it to be urine; he never discovered any purulent matter in her urine, nor had she any pain in the sphincter of the bladder, nor in the *Meatus urinarius*, either before, at, or after making urine; the paroxysm lasted generally three or four hours; as soon as these *Hydatides* came away (which they did not all at once making water, but at several times) the pain in her back, &c. abated very sensibly, and she continued easy and well the rest of the day, excepting an external soreness, which the pain had caused; the Dr. took these *Vesiculæ* to be at first membranous, since their consistence was so tough, as to bear taking out of the chamber-pot, and gentle handling; but he was afterwards convinced, that they

owed their origin to a glutinous slimy matter; because, upon standing long in fair water or urine, they quite disappeared, and were dissolved, making the urine or water look thick and turbid; by the use of medicines all these symptoms disappeared, and she continued well.

The Causes of the different Taste of Water; and the Edges of Razors; by M. Leewenhoeck. Phil. Transf. N° 273. p. 899.

M. *Leewenhoeck* took a drop of rain-water that was well boiled in a tinn'd water-kettle, with a good cover on it, so that no smoak could get in; this water being mostly exhaled, there remained abundance of little salt particles of an oblong quadrangular figure, whose thickness was almost equal to their breadth, and the upper parts of several were pointed like ground and polished crystal; but when he viewed them more narrowly, he perceived that from every angle there stood out a point.

Plate II. fig. 15. A and B represent two of these salt particles, wherein *M. Leewenhoeck* could perceive none of those points, that are plainly to be seen, fig. 16. between CD and E, and whereof there were several, otherwise very like fig. 15, A B: Afterwards *M. Leewenhoeck* took some rain-water, that was just ready to boil, so that he could see several air-bubbles rising from the bottom of the kettle; and after he had also exhaled this water, he discover'd abundance of the aforesaid salt particles, and in as large a quantity, as in the other water, that had been well boil'd; but besides these, there were a few salt particles in shape like fig. 17, F G and H, of which latter sort he could discover none in the water that was boil'd enough; from whence *M. Leewenhoeck* concluded, that these salt particles, which give the unboil'd water an unpleasant taste, might very probably be those we call the volatile salts, which by a great deal of boiling, are dislodged or evaporated out of the water.

M. Leewenhoeck had five new *English* razors brought him, which he viewed with his microscopes and found abundance of small notches in them, some of these were pretty large about the point; and in one of them, close to the edge, he observed a little hole he could see through; so that if the razors had not been very clean, and laid in oil, he would have imagined that rust had been the cause thereof; out of those five razors *M. Leewenhoeck* chose one, which seemed to him to have the fewest notches, and with that he caused himself to be shav'd; at first, it was very soft and easy, but at last it grew so painful that he could not endure it, and viewing the razor he found in it many more notches than at first;

first; M. *Leeuwenhoeck* took one of his own razors, which tho' it could cut pretty well, and he could use it in shaving, yet it was so full of notches, that one would wonder how it could cut a hair without causing pain; he took another, which he did not value much, and had used but very little, since it had been ground; he observed the back to be pretty rusty, but the edge had little or none; he scraped the rust off, and ground the razor with a grindstone, in order to get off the rusty part about the edge; then he pass'd it over a soft hone with water, to grind out the small notches the first stone had left, and make the edge the finer; he pass'd it once or twice thro' oil, after which he look'd upon it thro' his glass, and observed, that in six several places close to the edge, there were little holes quite thro'; and tho' with the naked eye one could perceive but a very little rust, and that only in one place, yet M. *Leeuwenhoeck* could see very plainly with his microscopes, that all those little holes were full of rust, which had eaten thro' the razor; he wash'd the back of his hand with plain water, and then took the said razor, and therewith scraped off the little hairs; then observing the razor again, he could perceive that those little holes were turn'd to notches, and that small pieces of the razor were broken out; M. *Leeuwenhoeck* observed several notches in a razor ground at another place, and never used, and still more, in another that had been used, and reckon'd a very good one; and he is of opinion, that if the metal of the razor be too soft, it yields to the hair; and if it be too hard, the hair causes several notches in it, and especially, when the razor meets with a stiff rugged hair, that was not sufficiently suppled with water; however it be, he never saw a razor without some notches.

Microscopical Observations, *by the Same.* Phil. Transf. N° 273.
P. 903.

M. *Leeuwenhoeck* was shewn a magnifying glass, whose chiefest excellency was, that one could see an object a great distance from it; as soon as M. *Leeuwenhoeck* put the said glass to his eye, he concluded there was a hole or cavity in it, by which the remote object came to be seen, and viewing it by one of his own glasses, he not only discover'd one deep pit or cavity in it, but several other lesser pits, which had not been ground out; a certain glass-grinder came to M. *Leeuwenhoeck* with a magnifying glass, whereby he said, he could see into metals and minerals; but M. *Leeuwenhoeck* answering, that the pores of metals were so close and impervious, that it was impossible ever to see thro' them, not

even thro' leaf-gold, tho' beat ever so thin; upon which he put the glass into M. *Leeuwenhoeck's* hand, adding, that he might see the light of the candle thro' a copper circle, which stood before the magnifying glass, and accordingly he saw a very faint light thro' the copper circle; which phenomenon was only occasioned by a small part of the glass that was not ground, as M. *Leeuwenhoeck* discover'd by an extraordinary magnifying-glass.

It sometimes happen'd that small particles by the bursting of glass, or sparks flying out of wood-coals, had got into M. *Leeuwenhoeck's* eye, and caused it to smart, upon which he used to arm his eyes with spectacles; now he observes, that when he looks thro' one of his glasses by candle-light, that near the upper part of the eye in the *Tunica cornea*, there appears a fine small flame of a candle inverted; and opposite thereto, two round clear lights, so very small, that the flame of the candle is not to be perceived therein; from hence M. *Leeuwenhoeck* concluded, that the *Tunica cornea* had lost, by the wound received from those particles of glass, somewhat of its roundness, which occasioned those appearances, and that when the wounded part stood just before the sight, it obstructed it, &c. He also observ'd, that in several places of the *Tunica cornea*, there lay veins no longer than the breadth of two or three hairs put together, wherein he could perceive the globules of blood very distinctly; these vessels were so small in their diameter, that they could contain but one globule, and the blood had no motion; the vessels seem'd to M. *Leeuwenhoeck* to be broken off from other blood vessels; and when the particles of blood are a little crowded together, or when one of those longish vessels are somewhat bended, it appears to the sight, as if one saw a thick cloud; the eyes are surrounded with this cloud of small particles, but more at one time than another, for some are dispersed, and then others arise in their stead; upon viewing these vessels with their globules of blood thro' a microscope against a candle, or other strong light, they seem'd to be in continual motion; whereby those particles, that are in the *Tunica cornea*, be their motion never so small, seem to us, as if they were moving in the air; but by a strict examination we shall find, that they are one and the same particles, which sometimes appear ascending, and at other times descending; besides, we find in the *Tunica cornea* round particles that lie scatter'd about, which M. *Leeuwenhoeck* judg'd to be globules of blood; it has often happen'd, when he look'd thro' his microscopes against a strong light, that he saw a vast number of exceeding small particles, that had all a glittering motion; which M. *Leeuwenhoeck* takes to be in the crystal.

crystalline humour of the eye, between the *Tunica cornea* and *chrySTALLINA*, and their Motion is occasioned by pressing the *Tunica cornea*, when we shut our eyes close together.

M. *Leewenboeck* had often taken several sorts of moist substances, and laid them on a very clean glass and viewed them, as also his breath thro' a microscope, when he could see their fine subtile particles rise up from the glass like clouds, and at last quite vanish, so that he could not perceive the least remnant thereof; and he is absolutely of opinion, that tho' he could see the *Effluvia* of bodies, that were a thousand millions of times smaller than those, yet he could not perceive the perspirations of bodies, and much less the imaginary influences of the stars.

A New kind of Walnut-tree by M. Reneaume. Phil. Trans. N^o. 273. p. 908.

THE *Nux Juglans sive Regia*, or walnut-tree, has been described by several authors, who seem to have known but six species thereof, tho' M. *Reneaume* can reckon nine; they confounded with the common sort, that which the country people call *Noix Angloises* which may be distinguished by the name of *Nux Juglans putamine durissimo*, which appear to M. *Reneaume* to be the same with what in *Hermolaus* and the *Historia Lugdunensis* is called *Moratia moracilla*, and which *Cesalpin* calls *Surda*: Besides, the same authors have not distinguish'd another species, which might be called *Nux Juglans fructu precoci*, because they are sooner ripe than the others, and eaten about the feast of St. *Jonh en Cernaux*, which has given them amongst the country people, the name of *Noix Joannettes*; as for that species M. *Reneaume* is to treat upon, he cannot find any author that knew of it, and therefore he calls it *Nux Juglans, folio eleganter dissecto* or *Acanthifolia*.

The oil which is pressed out of the walnut-tree in certain provinces, is used instead of butter and olive-oil; in *Berry*, where they have very good wool, and where they trade very much in cattle, yet they have but very little butter, and that little which they have is worth nothing, and is very dear; so that they use nut-oil in dressing their meat; for this reason, there is a vast number of walnut-trees planted in the middle of the plow'd lands, in such a manner, that afar off one would take these lands for woods of walnut-trees; the want of these trees in this country obliges the inhabitants to cultivate them, which

which they do in particular places, as in a sort of nursery, in order to plant them afresh, when they die, whether it be of age, which is rare, or whether they decay, or are fell'd for timber to work withal; in autumn, M. *Reneaume* being in an orchard two leagues from *Selles* in *Berry*, where they bred up a vast many walnut-trees, he perceived in the middle a sort of leaf, or foliage he had never seen before, and which he examined; and by the taste, smell, wood, and figure of the tree, he concluded it was walnut, tho' he did not remember ever to have read, or heard of any sort like it; the tree was very young, and never bore any fruit, perhaps, because it was in a manner choak'd up, and that there was neither air, nor nourishment enough, by reason of the great number of other walnut-trees, which grew round about it; it was near six foot high, and two inches in diameter at the bottom; it was adorned at top with several branches, and, as the country people said, it was about 8 or 9 years old, and they had always found its leaves, like those M. *Reneaume* saw: The common walnut-tree bears its leaves by pairs, upon a stalk which terminates in a similar leaf, that is ordinarily bigger than the rest; and it has very seldom above three pairs upon each stalk; this sort had sometimes four or five pairs, and sometimes more, which are one while opposite, another while alternate, tho' its leaves appear smaller, than those of the common walnut-tree; because, of the cuttings or slashes; yet they are nevertheless as big, taking their circumference from the extremities of these indentures or slashes; the first pair, and sometimes the second are less cut than the rest, being so only on the circumference; but the others are cut so deep, that it looks, as if the nerve in the middle of the leaf was only a stalk; and the cuts of the leaves are sometimes by pairs, other times single on one side; these leaves are sometimes forked at the extremity, and at other times they end in a point; in some places it looks, as if the leaf was torn on purpose, almost like the *Angelica Canadensis*, *foliis quasi Præmorsis*; there are others that seem to be double, as if the stalk or the nerve was winged, just like the winged stems or *Caules alati*; all these cuts and slashes are not like indentures, but end in a round; and notwithstanding all these irregularities, they look like those wrought leaves, which serve for ornaments to painters, almost resembling those which adorn the capital of the *Corinthian* order, or what in heraldy they call *Mantles*, or what the botanists call *Acanthus* or *Brancursin*: *Delechamp* has observ'd an aerial honey of a yel-

yellowish colour, upon the leaves of a walnut-tree, which can be nothing but an effect of its perspiration, as is found in all other trees.

The Asbestus, and the Manner of spinning and making an Incombustible Cloth thereof, by Signior John Ciampini.
Phil. Trans. N^o. 273. p. 911.

S Ciampini mentions four sorts of the *Asbestus* stone, of which he had specimens in his *Musæum*; the first was sent him from *Corfica* or *Corfu*; which was long, of a woody, form, and half a palm and more in length, of a whitish colour somewhat inclining to a reddish; the second sort is of a silver colour, softer and shorter, about three inches long, from *Sestri de Ponente* in *Liguria*; the third, which is the worst of all, resembles scales or *Laminae*, one upon another, like an onion, of a blackish earth colour, with some white, black, and dark red veins interspersed, scarcely two parts of a *Roman* inch long, and therefore it is fitter for making of paper, than for spinning or weaving; the fourth sort was given him by *S. Boccone*, and found in the *Pyrenees*, some of which was a *Roman* palm long; its filaments, tho' longer, were yet thicker and rougher; he also says, that he heard of another sort in *Montibus Volatranis*, and afterwards quoting some passages out of *Pliny*, *Dioscorides*; and other authors, that have mention'd this stone, and the cloth made thereof, he touches upon its supposed use for the wicks of sepulchral lamps, and from some experiments, he concludes it unfit for that purpose, having always found the wicks made of it go out, and not attract the oil for the flame; next, he tells us, he had kept it for three weeks in a glass-house fire, but he found it unaltered, tho' it would not preserve a stick wrapt in it from the fire, from whence he concludes that the *Amiantus* loses nothing in the fire, because it does not burn, nor flame, but in the handling it wastes, tho' not much, as he found by an exact ballance; lastly, he proceeds to shew the manner of spinning it, which he tried thus; first, the stone is laid in water (the warmer the better) for some time to soak; then it is open'd, and divided with the hands, that the earthy parts may fall out, which are whitish like chalk, and hold the thready parts together; this makes the water thick, and milky; and this is repeated six or seven times with fresh water, where it is again open'd, and squeezed, till all the heterogenous particles are wash'd out, and then the flax-like parts are collected, and laid in a sieve to dry; after which lay the *Amiantus* between two cards, such

as wool is carded with; where let it be gently carded, and then clapt up between the cards, so as that some of it may hang over the sides; then lay the cards fast upon a table or bench; take a small reel made with a little hook at the end, and a part to turn it by, so that it may easily be turn'd round, this reel is to be wound over with fine thread, then having a small vessel of oil ready, with which the fore-finger, and thumb are constantly to be kept wet, both to preserve the skin from the corrosive quality of the stone, and render the filaments thereof more soft and pliant; thus by twisting the thread about upon the reel, with the *Asbestus* hanging out of the cards, some of it will be worked up with it; by little and little, this thread may, with care, be woven into a coarse sort of cloth, and by putting it into the fire, the thread and oil will be burnt away, and the incombustible cloth will remain: But finding this way of uniting the stone with the thread very tedious, instead of the thread, he put some flax upon a distaff, and by taking three or four filaments of the *Asbestus*, and mixing them with the flax, he found they might easily be twisted together, and the thread made thus, be much more durable and strong; so that there is no need of carding, which rather breaks the filaments, than does any good, only after washing, open and separate the filaments upon a table, and take them up with the flax, which is sufficient: Of his four sorts of *Amianthi* S. *Clampini* found that from *Corfica* the best, being long and soft; and the *Cyprian* sort the worst; tho' he doubts whether his was of the best sort, since the *Cyprian* is commended by *Pancirollus*, and others he quotes: As to the making of paper, he says, in washing the stone there will remain several short pieces in the bottom of the water, and of these, paper may be made after the common method.

He concludes with the best way of preserving the cloth, or any other thing made of the stone, for by reason of its exceeding dryness, it is very apt to break and waste; which is by always keeping it well oiled, the only preservative for it, and when the cloth is put in the fire, the oil burns off, and the cloth comes out white and purified.

Some large Bones found in a Gravel-pit near Colchester; by Mr. John Luffkin. Phil. Transl. N°. 273. p. 924.

IN digging for gravel there was found at *Wrabness*, a small village, situated in the most eastern parts of *Essex*, upon the river *Stowe*, near *Harwich*, divers bones, of an extraordinary

dinary bigness, at fifteen or sixteen foot beneath the surface of the earth.

We read in *Cambden*, p. 351, that in the time of King *Richard II.* and in the reign of Queen *Elizabeth*, there were found in the most eastern promontory of *Essex*, at a place called *Odulfness*, which Mr. *Luffkin* takes to be *Walton*, large teeth, and bones of an extraordinary bulk, which were esteem'd giant's bones; but Mr. *Childrey* in his *Britannia Baconica*, p. 100. rather thinks them to be the bones and teeth of some elephant, buried there by the *Romans*, and Mr. *Luffkin* is apt to believe the same; 1. Because, they far surpass in magnitude the bones, &c. of the largest animals we have at this day in our island. 2. Because it is evident from *Dion Cassius*, as quoted by Mr. *Cambden*, in his *Britan.* p. 347, that a great number of elephants were brought over into *England*, by the Emperor *Claudius*, in his wars with the *Britons*; yea, into *Essex* itself, as appears from the same *Dion* a little after in these words; *Claudius having at last joined Plautius, and taken the Command of the Army, pass'd the River, meaning the Thames, and upon a fair Engagement with the Enemy, who were posted there to receive him, obtained the Victory, took Camolodunum, &c.* 3. In comparing this bone with the osteology of Dr. *Mullins* in his anatomical account of the elephant burnt at *Dublin*, &c. Mr. *Luffkin* found that it perfectly agreed with the *Os humeri* thereof, not only as to outward appearance, but also as to measure; from which circumstances we may conclude, that these were the bones. &c. of some elephant, rather than of any other animal; and it seemingly appears to Mr. *Luffkin* that these bones and teeth mention'd by Mr. *Sommer*. *Phil. Trans.* N^o 271. might have been those of some elephant, rather than of the *Hippopotamus*; and that, 1. In respect to the place; for as Mr. *Cambden* says in his *Britannia* p. 197. speaking of *Chilham* in *Kent*, of which this *Chartham* is a neighbouring village, and situated in the same down, and on the same river *Stowre*; that it is a current report amongst the inhabitants that *Julius Caesar* incamp'd there, in his second expedition against the *Britons*, and thence it was called *Julham*, as if one should say, *Julius's* station or house; it appears further, *Britan.* p. 208 that *Rhatupia* (which whether *Richborough* or *Stoner* matters not) situate near *Sandwich*, was the place of *Claudius's* landing in *Britain*; and that thro' this *Down* was his nearest way to the *Thames* (is indisputable) whither he was going; so that it is highly probable, that during the stay, passing, or

repassing of the *Roman* armies through these *Downs*, one of their elephants might perish or die, and be buried there. 2. By the teeth themselves compar'd with the descriptions of *Mullins's. Anatom.* p. 40. You find them the very same, as to breadth, depth, and their being *Molares*. 3. And lastly to solve that great difficulty, which oblig'd Mr. *Somner* to imagine this *Down* to have been an *Æstuary*, that his *Hippopotamus* might therein dig itself a grave; otherwise, says he, how should these bones be found at such a depth? Or who with reason can imagine, that any land animal could ever have had at first so deep a burial? But, it is easily explain'd, why these bones should at this day be found at such depths, if we consider the alteration, or rising of the valleys, by the continual washing down of the loose earth, or soil by rains, and snows from the neighbouring hills, and by the annual rollings of the grass, sedge, &c. growing upon it; for proof whereof, take the following instance from *Dr. Plot's Nat. Hist. of Staffordshire*, Ch. vi. p. 48. p. 220. speaking of a moss, &c. wherein there was found a parcel of coins of *Edward IV of England* (supposed to have been lost in a purse, or cloth, now rotted away) at 18 foot depth, which being about 200 years since they were found; by computation this moss grew about a foot in 11 years, or an inch and nearly a twelfth part of an inch in a year; divers other instances of alteration are mention'd in the same history as in *Ch. 3. par. 11. 12.* and *Ch. 6. par. 45, 46, 47, &c.* Now it will easily be granted, that if this moss grew above its former surface 18 foot in 200 years, consequently this vale, or *Down* might advance itself 17 foot in almost 1700 years.

The Indian Varnish; by Dr. Joseph del Papa. Phil. Trans. N° 274. p. 947.

THE using and the handling of the *Indian* varnish; or lacker, so far as it is necessary to lay it on subjects to be varnished, having produced such extraordinary effects on *Sig. Ignatio*, and more remarkably on his maid-servant; as great swellings of their heads, eyes, arms, and indeed almost of their whole bodies, with an intolerable itching, inflammation, and pimples, may well excite our curiosity to search into the reason of this extraordinary *Phenomenon*; and the rather that among the numerous ingredients of the *Materia medica*, and other natural substances, there is not one that produces an alteration equal, or similar, to what this does in human bodies; all our liquors, and corrosive spirits only affect the parts of the body

body they immediately touch, and diffuse not their mischievous qualities over the whole body, as this varnish does; poisonous fumes, or steams from mercury, or antimony, manifest their malignity on the brain, and nerves, by great and incurable disorders, whereas the effluvia and touch of this varnish affect only the external skin of the body; and tho' in a very strange manner, yet not destructive of the part affected, which grows well again of itself; there are, indeed, some juices of roots, and herbs, and other parts of vegetables, which by touching our flesh, either inflame, or exculcerate it, or produce swellings, pustules, and Itchings, but all these cause the disorder only where they touch, and do not spread their invisible venom over other parts of the body: In fine, Dr. *del Papa* does not know an instance of any one thing, which either touch'd with the hand, or insinuating itself by its fumes, or vapours into our body, is able to produce almost over the whole skin, inflammations, swellings, itching, and pustules, as if the whole body were stung with a vast number of wasps, or gad-bees, for such exactly are the effects produced by this varnish.

The great difference between this, and all things else, and the ingredients whereof it is made, being absolutely unknown, render it impossible to penetrate into the true cause of the abovementioned effects; yet we may propose it as a probable conjecture, that this varnish contains some ingredient, which when hot, emits into the body a subtile vapour, which only affects the skin, without touching any other part; after the same manner, *Cantharides* not only taken inwardly, but outwardly applied, communicate a venomous quality of a particular nature, affecting only the kidneys, bladder, and urinary passages, causing sensible pains and excoriations therein, without affecting the other *Viscera* in the least; some physicians are of opinion, that this particular disagreement of *Cantharides* with the urinary ducts, is occasion'd by the salt, and nitre contained in the urine, which give life, and vigour to the poison of the *Cantharides*, without which salt their poisonous quality could have no power; so after the same manner, it may be said, that the noxious fumes of the varnish become hurtful to the skin, by mixing with some juice they meet with therein, especially in the milliary glands, whereof the whole skin is full: It is certain, that the varnish exerts all its malignity on the skin, the *Viscera* and blood being untouched, and the Dr. observ'd that the maid (at the same time that almost

her whole skin was hard, inflamed, swelled, and full of pustules) had yet no fever, head-ach, nor any inward ailment; and as to what disorders Sig. *Ignatio*, or she felt in their eyes, this was a swelling affecting the eye-lids only, which may be reckon'd as parts of the skin; but it is possible, the bad effects of the varnish were more sensible and troublesome in that part, as the skin there is thinner, and more delicate than on the rest of the body; this varnish, therefore, is only an enemy to the skin, and to produce this effect, it is not necessary that the varnish be heated; for, tho' cold, it emits the same noxious steams, which insinuate themselves into the body, especially when touched and handled.

Dr. *Del Papa* had several times spread a great deal of this varnish, hot upon the naked skin of poultry, and they never received any hurt from it, either internal or external; he also made other fowls swallow crumbs of bread sopp'd in the varnish, and they seem'd to like it very well; others he pricked in the breast, till the blood came, and then anointing them all over with this varnish, instead of hurting, it prov'd a balsam to heal them; it is possible, that this varnish does not produce the same effects on the very thin skin of fowl, as on that of men, because they are very different from each other, both in their structure, and in the quality of the humours contained in them: The Dr. observ'd that this varnish is in a great measure compos'd of gummy, and unctuous matter; for it is very light, swimming upon brandy and oil, and not uniting either with water, or spirits of wine, or any other liquor, but oil alone; and besides, it burns, or takes fire; for the Dr. dipp'd cotton therein, which burnt all away to ashes, tho' at first there was some difficulty to make it take fire, which might be owing to the admixture of some other ingredient, that was not unctuous; and lastly, its composition, when observ'd with the microscope, appears like that of oil, or lard, or some such unctuous substance; and from all these circumstances, it is probable, that it consists of the gum, or juice of some resinous herb, or tree, or of the fat of some animal, or hog's lard; and possibly the gall of some animal may be mix'd therewith, to make it the more easily receive a smoothness and lustre, as limners use to put gall to their water-colours, to make them run, and spread the better; and that the mischief, which is found by touching, and using it, may proceed from hence: The Dr. is persuad'd, that there is no mercury in this varnish; not only, because it is very light, but because he had been very

very careful in trying, whether gold would discover any signs of mercury, either in the body, or smoke thereof, but in vain; and besides, mercury produces very different effects in our bodies, from those of this varnish: The Dr. observed, that the varnish mix'd with spirit of vitriol, or juice of lemons, or vinegar, or spirits of wine, causes no ebullition, nor change of colour; but when taken out of the vessel, and exposed to the air, it readily changes colour, becoming at first reddish, and afterwards almost quite black; the outward skin next the air becoming very hard and black; this skin is very thin, under which the rest of the varnish remains soft and fluid, of the colour, and consistence of honey; and as often as you take off this outward and hard black skin, there will be form'd immediately another like the former, and this as often as you please to repeat the experiment; so that the whole substance of the varnish will in time, be changed into these hard and black skins: In fine, this known quality of the varnish is worth observing; for, having spread some of it on the naked breast of some fowl, and leaving it there for three days, the Dr. afterwards found, between the dried varnish and the flesh, the place all festered, and full of a yellowish *Serum*, but without any further harm; the Dr. attempted the same thing on dogs and cats, but without success; for these animals soon take off the varnish with their tongues and claws, and so receive no hurt by it; perhaps, the experiment might succeed better on horses, and such like animals, if the varnish has the same corrosive or caustic quality on their bodies, that it has on poultry.

Observations on those Solutions and Fermentations, which may be denominated Cold; and a new Thermometer; by M. Geoffroy. Phil. Trans. N° 274. P. 951.

THE different researches M. Geoffroy made into the nature and properties of salts, together with the different experiments he tried, in examining their solutions or mixtures in certain liquors, gave him occasion to observe, that the mixture of the greatest part of salts in several liquors is attended with a sensible coldness, notwithstanding the prompt, and violent fermentations, which ensue on several of these mixtures; M. Geoffroy distinguishes these solutions, or mixtures, into two classes; the former comprehends all the simple cold solutions, that is, such as are not accompanied with any sensible fermentation; the second only takes in the cold solutions of salts, which are attended both with a sensible fermentation, and a coldness of the liquor.

Class

Class I. Of simple cold Solutions.

M. Geoffroy put a pint of common water into a phial, and an ordinary thermometer of 18 inches in the water, and so let it lie for some time to fit itself to the temperature of the water; he afterwards put into the water 4 ounces of *Sal Armoniac*, and the liquor in the thermometer descended 2 inches and 9 lines, in less than a quarter of an hour; observing the same circumstances, he made the same experiment with salt-petre, and the liquor in the thermometer descended 1 inch and 3 lines; the same experiment being made with vitriol, the liquor in the thermometer descended almost an inch; sea-salt made the liquor descend but 2 lines; all the *Alcaline* volatile salts cool'd common water by their admixture, causing the liquor in the thermometer to descend some lines; but M. Geoffroy observed, that they caused it to do so more or less, according as they were more or less purified; and salt of urine seem'd to do so soonest of all; as for the *Alkaline* lixivious salts, they were so far from cooling the water, that they heated it more or less, according as they were more or less calcined: Upon the whole, one may observe, that the salts for heating the water ought to be purely alkalious; for if they approach near the nature of nitre, or sea-salt, they heat the water but little, or not at all, or rather cool it; this is also done very considerably by salt of tamarisc, extracted from the *Lixivium* of the ashes of this vegetable; *Sal Armoniac* mixed with vegetable acids, as distilled vinegar, juice of lemons, or verjuice, gave no signs of fermentation, but cool'd these liquors very much; an ounce of *Sal Armoniac* cast into 4 or 5 ounces of distilled vinegar, caused the liquor of the thermometer to descend 1 inches and 3 lines; the same salt, mixed with the juice of lemons, caused the liquor to descend 2 inches; it does the same with verjuice.

Class II. Of cold Fermentations.

Salt-petre cast into its acid spirit, raised some smoke, or vapours, and caused the liquor of the thermometer to descend 4 lines; from saltpetre, mixed with the spirit of vitriol, there exhaled a great quantity of smoke, which made the liquor descend from 6 to 7 lines; in these two experiments, M. Geoffroy put half an ounce of salt to 3 ounces of liquor; he put half an ounce of *Sal Armoniac* into 3 ounces of spirit of nitre, and the liquor in the thermometer descended 3 inches and 5 lines; this mixture emitted some vapours, which seem'd more considerable, than those which ordinarily exhale from spirit

spirit of nitre alone; he pour'd half an ounce of *Sal Armoniac* into 3 ounces of spirit of vitriol, which made a violent fermentation; the matter was considerably raised, and much vapour exhaled, the liquor was very thick, and the thermometer fell 3 inches and 6 lines; he observed, that the vapours exhaled by this mixture were hot, and that they raised considerably the liquor of the thermometer, which he held hanging over the matter, tho' what was dipped therein did descend, and shew a very great cold; sea-salt, mixed with acid spirits, heats the liquors, instead of cooling them; being mixed with spirit of salt, it raised the liquor of the thermometer some lines, without shewing any sensible fermentation; with oil of vitriol it ferments with a noise, and raises a great smoke; the liquor thickens, and becomes a sort of clear jelly; the liquor of the thermometer rises very much in this mixture, and the heat is sensible to the touch; all the volatile alkalious salts, mix'd with different acid liquors, excited a fermentation more or less strong, according to the acidity of the liquors, and the purification of these salts from their fetid oils; they all made the liquor of the thermometer fall; but that which did so the most considerably, was the salt of urine; an ounce of volatile salt of urine, very well rectified in 4 ounces of distilled vinegar, made a strong fermentation; the matter was elevated very much, and with a noise, and the liquor in the thermometer fell in the fermentation an inch and 9 lines; an ounce of volatile salt of urine in 3 ounces of spirit of vitriol, raised a violent fermentation, during which the liquor of the thermometer fell 2 inches and 4 lines; the mixture of salt of tartar, or other fixed alkalious pure salts, with acid liquors, excited fermentations with heat; M. *Geoffroy* made all these experiments with the same thermometer, when the weather was sufficiently cold, and the temperature of the air equable enough.

As to the reason of these experiments, M. *Geoffroy* first of all examin'd the simple cold solutions; and having, with all physicians, fixed this principle, that cold is nothing, but the diminution of motion, so that the coldness which the salts bring upon the water, seems to be occasioned from this, that the salt particles being without motion, and dividing that liquor, diminishes it so much the more, and this is what produces the cold more or less in the same liquor: There is one thing to be observed; viz. that some time after the solution is made, the liquor of the thermometer rises again a little, which may be occasioned by this, that the subtil matter which glided abundantly between the liquid particles, had ceased to glide there
in

in the same quantity for some time, the gross particles of the salts intercepting their passage; but these saline particles being divided by little and little, they again open'd the passage to the subtil matter; this gave the liquor more motion, than it had at the beginning of the solution; but yet less than it had, when it was pure, and without mixture; the saline particles, altho' dissolved, abating somewhat of their motion: We may easily apprehend, why lixivious salts, purely alkalious, and well calcined, as also the salt of tartar, heat the liquor, and are very far from cooling it, if we consider that these salts in the strong calcination, which they have undergone, are impregnated with several fiery particles, which they imprison in their pores; these igneous particles regain their liberty, by the solution of the saline particles; and in the same time that these salts ought to slacken the motion of the aqueous particles, and cool it, the igneous particles being very active, augment the agitation of the watry particles, till they make it very hot: M. *Geoffroy* observes next, that *Sal Armoniac* cools the water wherein it is dissolved, more than any other salt; its cold equals that of water, which is ready to freeze; and it happen'd once, that in dissolving a good quantity of this salt in water, some drops which fell on the outside of the phial, in which he made the solution, did freeze, and the straw upon which the phial stood, being wet, was fastened to the glass for some time by the ice; and this, at a time when the weather was warm; he tried the same experiment several times after, in different ways, but without ever being able to produce ice; chance had apparently made him hit in this experiment, not only on a very exact proportion between the salt and the water, but also on a temperature in the water besides, which he supposes necessary; because, the solution being quick, the cold must also be more sudden and great, and this is that degree of temperature, to which he could never afterwards attain.

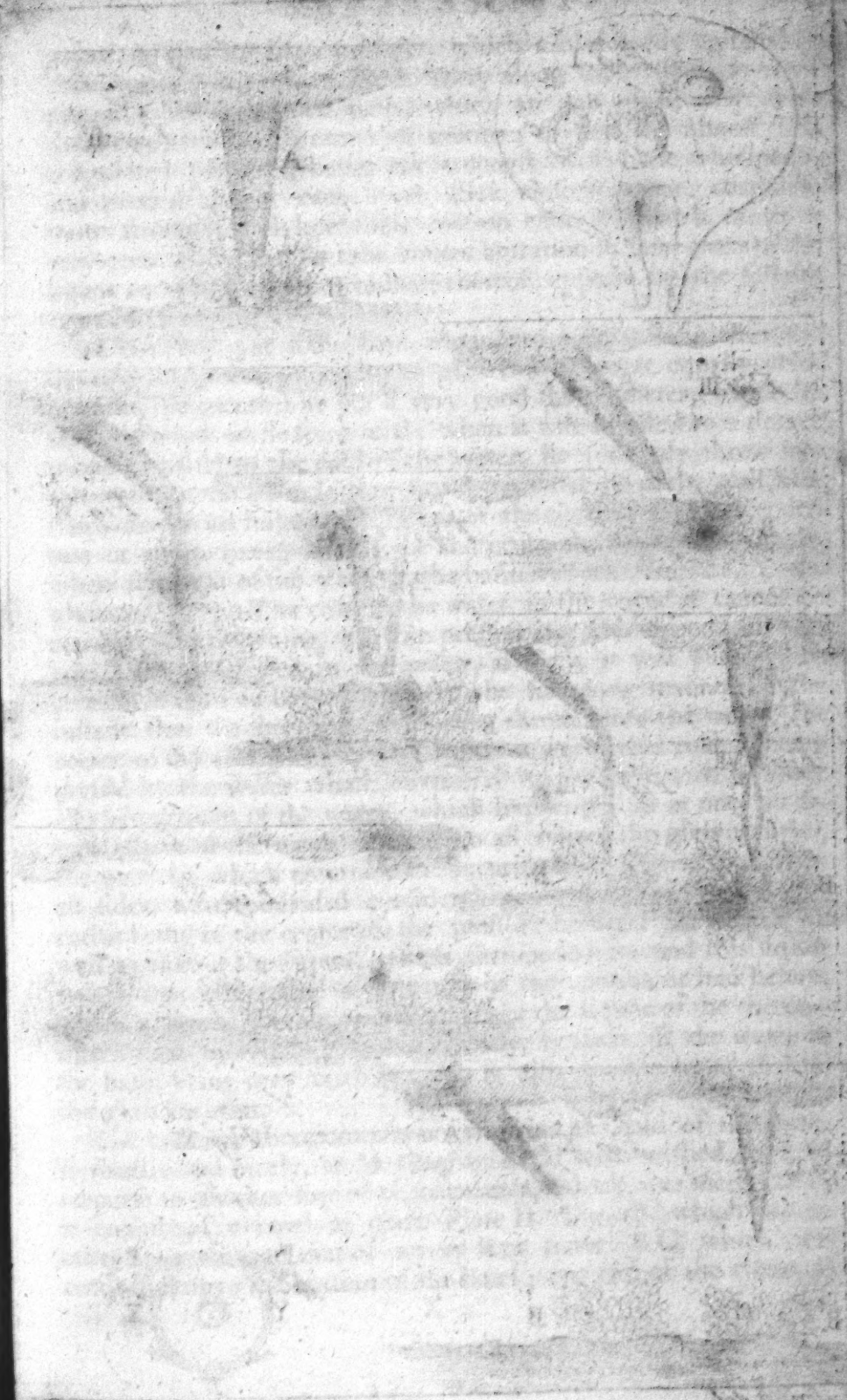
The great coldness of the solution of *Sal Armoniac* does not proceed from any difficulty it has to be dissolved, since it dissolves sooner than any other; and sea-salt, whose solution is difficult, and very slow, is that which least cools its dissolvent; on the contrary, it seems that the facility and readiness, with which it dissolves, may be the cause of this great cold, in this manner; *Sal Armoniac*, as every body knows, is a composition of sea-salt, and salt of urine; the one very easy, and the other very hard to dissolve; the particles of sea-salt being imprison'd amongst the particles of the salt of urine, it happens, that
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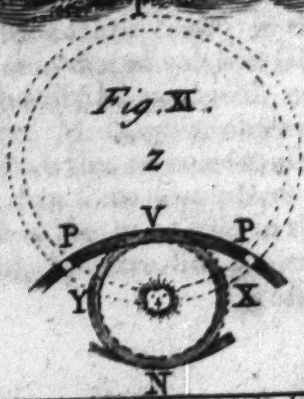
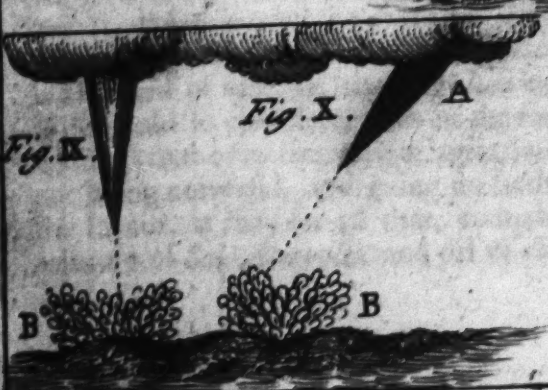
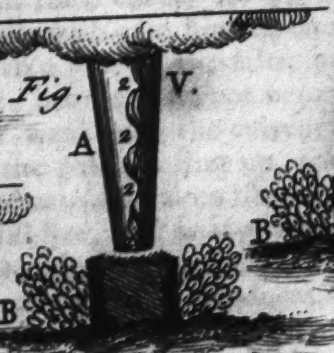
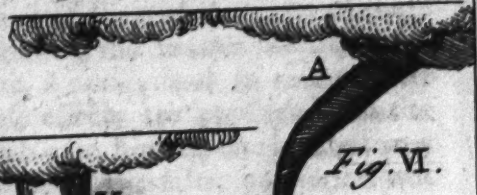
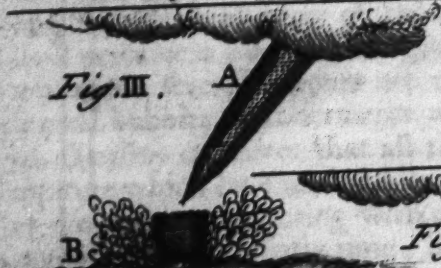
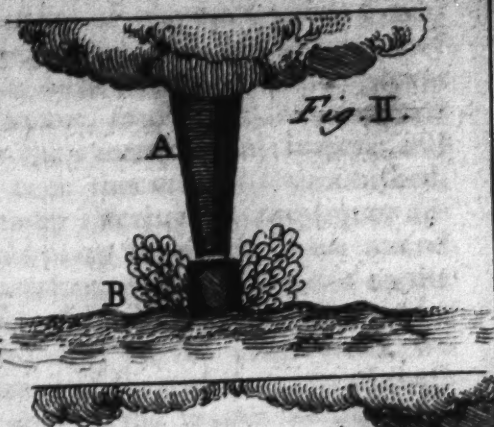
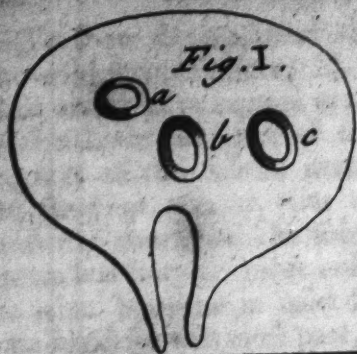
several of the aqueous particles, at first penetrating the saline particles of the urine, do there immediately lose much of their motion, and this motion grows weaker, by so much the more, as the aqueous particles meet afterwards with saline particles of another nature, whose resistance is much more considerable, than that of the salts of urine; so in the first instance of the solution, the motion of a great quantity of aqueous particles being very much abated all at once, by the salts of urine, and by the sea-salt it excited, in a few moments, a far greater degree of cold than that of any other solutions of salts, which water does not penetrate so readily.

It may be objected, that sea-salt being the hardest to dissolve, its solution should also be the coldest; to which M. Geoffroy answers, that this might be, if the water could penetrate suddenly into all its parts; but the slowness, with which it penetrates them, because of the close texture of the *Molecule* of this salt, hinders that the diminution of the motion of the parts of the water, cannot be so ready, nor consequently so great; whereas in *Sal Armoniac*, the parts of the sea-salt being extended by the salt of urine, the pores of the alkalious salt of urine are, like so many passages, open to the parts of the water, in order to penetrate the parts of the sea-salt in numberless places.

M. Geoffroy places in the rank of cold solutions, an experiment made by M. Homberg, which serves to prove what M. Geoffroy is going to say about the cold of *Sal Armoniac*; it is made thus, take a pound of corrosive sublimate, and a pound of *Sal Armoniac*, powder them, each a-part, then mix both the powders very exactly, put the mixture into a phial, pouring upon it a pint and a half of distilled vinegar, shaking it well together; this composition will be so very cold, that a man can hardly hold the vessel in his hands in summer; and it happened as M. Homberg was making this mixture, that the subject froze; in this experiment we see the cold still greater, than that in the solution of *Sal Armoniac* alone in common water; and this cold is caused by the corrosive sublimate, which alone is not at all, or at least very little dissoluble in distilled vinegar; so that the fluid parts of the distilled vinegar having quickly penetrated the parts of the *Sal Armoniac*, and having already lost a great deal of their motion, afterwards engaging in the pores of a body, which they could not dissolve, and having no more action than what is sufficient for that purpose, they lose there that little activity which they had, and coagulate, if not all, at least the greatest part; and this want of action is the cause of that great cold, which we perceive therein.

To shew the reason of the solutions of the second class; *viz.* the cold fermentations, M. Geoffroy owns, with physicians, that heat and cold in liquors are neither more nor less than the motion in the little particles of those liquors, caused by the continual current of the subtile matter in their intermediate spaces; and M. Geoffroy affirms, that every time this motion is diminished, and the course of the subtile matter interrupted, the liquor appears less hot, or more cold; this being supposed, if we attend to what happens in cold fermentations, we shall observe on the one hand for the most part, very considerable coagulations, and a very sensible thickening of the liquors; on the other hand, we shall perceive a very violent agitation of some of the parts of these mixtures; several vapours are exhaled, the matter swells, emits several bubbles, and ferments with a noise; and in this manner M. Geoffroy conceives that all these effects are produced: In the mixture which he made of salts with acid liquors, the greatest part of the liquor coagulating with a part of the salts, its motion was much abated in a little time; but its parts not being able to coagulate, without stopping, or weakening the current of the subtile matter, this matter finding the passages shut up, takes its course thro' the interstices, which remain'd between the coagulated particles, where the passage is still free, and as it glided in a quantity together, it caused a very considerable agitation in the parts it met with in its passage, which agitation produces the fermentation we perceive, raises bubbles of air and smoke, and swells the matter with so much the more violence, as all the parts of the liquor, being almost half coagulated, hinder the motion and agitation of these little particles; nevertheless this agitation, how violent soever it may appear, is not considerable enough to break the *coagulum* entirely, which is form'd in the liquor, nor consequently to overcome the cold, which causes this coagulation; all it can do, is to preserve still some kind of fluidity: In short, the more these mixtures are dispos'd to coagulate, the more they excite the cold; this we may see in the mixture of *Sal Armoniac* with oil of vitriol, in which the *coagulum* becomes so strong, that at last, it forms over the liquor a very thick saline crust; in the mixture of other salts with weaker acids, as in that of volatile salts with spirit of vinegar, the *coagulum* can hardly be perceiv'd, nor is the cold so considerable as in the former; M. Geoffroy observes farther, that even the violent agitation which this mixture causes, not being universal, and going no farther than some few places of the liquor, it may for all that, contribute to the great cold in the mixture of *Sal Armoniac* and oil of vitriol, by increasing the *coagulum*





gulum, so that the little particles, which are violently agitated in this mixture, not being able to carry along with them, in their motion, the coagulated parts, which are too gross, they drive them away from their center of motion; so that the almost half coagulated particles, being got amongst these little whirlpools, and pressed against each other, stick close together, coagulate more strongly, and lose their motion entirely, which causes a very great cold; and that the violent agitation in some parts of the liquor contributes to the coldness thereof, appears by the following experiment.

M. *Geoffroy* put some cold water into a great basin, and into the middle thereof a cucurbit of glass full of water equally cold, and into the cucurbit he put a very good thermometer, which he let lie a good while for a trial; when it was adjusted to a degree proportionable to the cold of the water, he suddenly threw into the water in the basin four or five shovels full of coals, well kindled, and in an instant, the liquor of the thermometer descended two or three lines; after some moments the liquor rose again, when the heat of the water in the basin was communicated to the glass cucurbit. The cold of the water in the cucurbit cannot be attributed to any thing, but the pressure, or sudden condensation, which the fire caused in the water, wherein it was put; which condensation may be explain'd in the following manner; in the instant that the burning coals were thrown into the water, the vortex of the subtle matter, by which it was turn'd round, being press'd by the water which environ'd it, scatter'd with violence all the particles of the water, which happening all at once in several places of the water in the basin all round the glass cucurbit, the particles which environ'd the cucurbit being at once press'd on all sides, were condensed considerably and successively; the cucurbit being in the center of the pressure bore all its weight, as well as that of the liquor, which surrounded it; and this liquor lost by its condensation very much of the motion it had before, which was considerable enough to make the liquor of the thermometer fall; this cold goes off quickly, because all the water in the basin being very much heated, it also quickly heats that in the glass cucurbit.

The ordinary thermometers not marking the cold of the water so readily and nicely, as M. *Geoffroy* could have wished, he had recourse to another sort of thermometer, which was more exact; it consists of a bowl of glass, Plate II. Fig. 18. which has no other aperture than that of a very long tunnel B C, which descends almost to the bottom of the bowl; one end of the tunnel B

is dipp'd in E, a liquor which is at the bottom of this bowl, and the rest is fill'd with nothing but air, which has no communication with the external air; when the air contain'd in this space is rarified by the external air, which touches the bottle, it presses at the same time the liquor E, and obliges it to rise by B in the tunnel B C; on the contrary, when it is condensed by the external cold, by not pressing upon the liquor E, it gives liberty to that which is in the tunnel to fall: The readiness with which the air condenses, or rarifies by cold and heat, makes the effects of this thermometer, much more sudden than those of any other sort; besides, the effects of this is much greater, the air being capable of a greater rarefaction, or greater condensation than any other fluid.

As for the sensible heat of the vapours, which are exhale'd from the mixture of *Sal Armoniac* with oil of vitriol, it is not difficult to find the cause, if we consider that these vapours are but the most volatile and active parts of this mixture, which the subtil matter raises with itself in pervading it; the motion of these particles is free in the air, and is but more repress'd by the too gross coagulated particles in the liquor; and by how much it has been retain'd and hinder'd for some time, it becomes so much the more violent, and is perceiv'd by heat, which is the ordinary effect of a rapid and violent motion.

If after having made a mixture of four ounces of oil of vitriol and an ounce of *Sal Armoniac*, you throw upon it a spoonful of common water, in the time when the fermentation is strongest, the cold is greatest, and the liquor of the thermometer falls with the greatest quickness; the fermentation ceases, and the cold changes immediately into a great heat, which makes the liquor of the thermometer to rise very high; the reason of this experiment may be easily conceiv'd, if we consider, that the water being heated quickly and strongly by the oil of vitriol, produces here the same effect; and this heat is sufficiently great at that time to destroy the cold of the coagulated particles, the water by itself being otherwise very proper to dissolve this *coagulum*.

An unusual Colic, by Dr. Davies. Phil. Trans. N° 275. P. 965.

A Person, aged between 50 and 60, had been for three or four years troubled with gripes, which generally return'd once a month, or thereabouts; his body being for the most part costive he therefore, was obliged to spur nature with *Daffey's* elixir, or aloes, and sometimes the smoaking a pipe of tobacco supplied the use of these medicines; coming from *London* he over-heated

heated himself with his journey, having walk'd a good part of the way; and as soon as he came home, he had a return of his colic pains, which continued upon him for 18 days, notwithstanding the methods commonly used in such cases, during which time he had no stool, excepting what the first and second clysters brought away; he complained when he was seized with this disorder of a pain in his right side, in the *Iliac* region; some time before he died, his belly swelled much, and was as tense as a drum; at first he vomited for two or three days, which left him, and did not return till just before he died, which was at the expiration of the 18th day, at which time he brought up some black choler, but never, during his whole illness, any of the *Fæces*: Upon opening the *Abdomen*, some black choler was found in the stomach; the *Duodenum* and the rest of the *Intestina Tenuia* were void of *Fæces*, but very much inflated with wind; and tracing the guts, as far as the *Cæcum*, it was found of a blackish colour; and from thence, for about a yard in length, the *Colon* was so mortified, that the *Fæces* had made their way thro' it in several places into the cavity of the *Abdomen*; about two inches of the mortified gut was fastened to the *Peritonæum* on the right side; this part of the *Colon* was extended with a great quantity of *Fæces* of a soft consistence; at the extremity of the mortification, towards the *Rectum*, the obstruction which caused all these disorders, offer'd itself to view very plainly; for about 10 inches of the *Colon* was doubled, as if you had taken and folded up a piece of tape; the two contiguous surfaces of the duplicature adhered so firmly together, that you could not separate them, without tearing the external coat of the intestine; upon separating this coalescence, there fell from that part a whitish *Mucus*; the adhesion was about three inches broad; the middle of the duplicature, which made an acute angle, and where the *Fæces* stopp'd, was smaller, and the membranes thinner, than in any other part of the gut; from thence towards the *Rectum*, the *Colon* was found, and void of *Fæces*, occasioned by the frequent use of clysters.

The Isthmus between Dover and Calais; by Dr. Wallis. Phil. Trans. N° 275. p. 967.

MR. Somner N° 272. p. 882. is of opinion (with Mr. Camden, and other Antiquaries) that it is highly probable, if not absolutely certain that *France* and *England*, or *Gaul* and *Britany* were anciently joined by an *Isthmus*, or neck of land, where now is the narrow passage between *Dover* and *Calais*, which

which several ages ago (beyond the reach of any history now extant) was, by the violent beating of the sea on both sides thereof, worn away, or broken thro'; whereby, what was once an *Isthmus*, is now become a *Fretum* or narrow sea; in support of the same opinion Dr. *Wallis* adds one argument more, (of which M. *Cambden* takes no notice) *viz.* the ancient *Gauls*, and *Britons* using the same language, and the great intercourse between the *Druides* in *Gaul*, and those in *Britany* (of which ancient authors take notice) which is not likely to be the case, if there had not been an easy communication between the one, and the other; which, tho' it be not a physical argument (as those of Mr. *Cambden* are) is a good moral inducement, in confirmation of them.

To inforce Mr. *Sommer's* arguments, Dr. *Wallis* considers, what must have happened, if this hypothesis be true, and how it agrees with what we see. 1. If there was such an *Isthmus* once, in that place where now is the *Pass* between *Dover*, and *Calais*, then the great seas on both sides must continually beat upon it, with a fierce impetuous tide, twice in 24 hours; *viz.* the northern sea between us, and *Holland*, called the *German Ocean*, on the eastern side; and the western sea, between us, and *France*, called the *British Ocean*, on the western side, which, in process of time, may well be supposed likely enough to wear away, or break thro' a narrow *Isthmus*; the western tide coming in fiercely between us and *France*, and fretting on the coast on both sides, must needs be supposed to bring with it, not only a great deal of soil, sand, or mud, but being stopp'd in its current, by this *Isthmus*, did not deposite it (as might be thought) on its side, which might strengthen it, but found an opportunity of discharging itself on the spacious level of *Romney-marsh*, fretting that *Isthmus* as it came along, and then, at the time of the tide's recess, letting it fall on that level, and lodging it there; but then again, fretting that *Isthmus*, and the coast all along, as the tide returned with a like force, as it came in; which gives us a fair account, both how that *Isthmus* might be washed away, and how that level might be raised to the height it is now at; for, no man can doubt (who well knows the situation of the place, and the nature of the soil) but that all that level had heretofore been sea; and even, at this day, it lies so much lower, than the surface of the sea at high-water; that much of it would be overflowed every tide, if not defended by *Dimchurch Wall*, for several miles together, whether it had the like opportunity of such an in-draught, and in what proportion on the *French* coast, the Dr. cannot tell.

The northern-sea, between us and *Holland*, must in like manner, have beat on the east-side of that *Isthmus*, with a like impetuous tide, twice in 24 hours; but, being stopped there in its course, would have the like opportunity of discharging itself on the coast of *Holland*, as the western-sea did on *Romney-marsh*: whence it is that *Holland*, and *Zealand*, which, by the consent of all, is judged to have been once sea, is now raised 30 or 40 foot higher, than it had been formerly; and the same northern sea, which, upon this account, hath so large an in-let, eastwards, on the coast of *Holland*, would, westwards, insinuate itself likewise on the *English* coast, wherever it might find low grounds; which is the case of this large valley, where now runs the river *Sture*, *Stoure*, or *Esture* (which name it is supposed to have taken from the corruption of *Æstuarium*) for more than 20 miles, entering at the low grounds near *Sandwich*, close by that *Isthmus*, and running up that level by *Canterbury*, *Chartham*, *Chilham*, &c. as far as *Ashford*, or farther; which valley had once been much deeper, than it is now; for, it seems, that even at *Chartham*, which is now 12 miles from the sea, the ground is raised at least 17 foot; and the soil at that depth is found to be of a like condition, with that, where the sea is known to have been; and nearer to the sea, it may well be presumed to have been still deeper; which is confirmed, as Mr. *Sommer* tells us, by the reliques of a marine animal found there, as also anchors, shells of fish, dug elsewhere in the borders of this valley, at a great depth under ground: Now, that the sea may thus raise the ground on such in-draughts, by sand, soil, and mud, conveyed and lodged there at every tide, is not at all unlikely; for, we see the same at this day, particularly, in the isle of *Oxney*, near *Romney-marsh*, where was a low level, often in danger of being overflowed by the river *Rother*; but, somewhat more than three-score years ago, the sea being let in, hath raised that level very considerably, by bringing in, and lodging there, a considerable deal of soil and mud every tide; but withal, it has so fretted the channel by which it enters and returns again, that the channel by *Rye*, which, within the Doctor's memory, was so shallow near (what was called) *Kent-bridge*, that it was fordable; but now, by the tides entering, and returning, that bridge is long since swallowed up, and the channel become so broad, and deep, that a vessel of good burden might ride there at anchor, which is a proper resemblance of the seas fretting this *Isthmus*, and filling up the *Æstuaries* on both sides thereof: The like, in a good measure, is to be seen at the *Dogger-sands*, which is a bank

bank of sand lying obliquely, from about the coast of *Norfolk*, towards the coast of *Zealand*, or north part of *Holland*; which is the place, where the northern, and western tides, since the rupture of the *Isthmus*, do now meet, and there (at slack-water, for about an hour, or at the turning of the tide) deposits the mud, and sand, which, by their rapid motion, is brought thither both ways, and which is supposed to be the true cause of that sand-bank; whether this, in process of time, may form a new *Isthmus* there, (if the world last long enough) the Dr. cannot say; but, he is apt to think, that the former *Isthmus*, if the tides had stopped there, and had not found those in-draughts, whereon to lodge what is washed from thence, might have continued, and been more strengthened, by what, on the return of the tide, would daily be lodged there: And upon this account it is, the Dr. thinks, that the *Isthmus* at *Corinth*, tho' beat upon by the two seas, which give it the name of *Bimaris Corinthus*, is not thereby destroyed, because, there are not such tides to wash it away, nor such in-draughts, whereon to lodge what might be washed from thence; but the case is much otherwise with this *Isthmus* of ours, where all circumstances concur to countenance this hypothesis; the steep cliffs at *Dover*, and those at *Calais*, answering directly the one to the other, and appearing to view, as if, what had been between them, had been violently torn away, as also the intermediate sea, even at this day, being much shallower at that place, than on either side of it (as *Cambden* well observes) are strong presumptions, that there had been formerly such a conjunction.

The greatest doubt in this case is, that there is no history extant, which takes notice of such an *Isthmus*, or of such a rupture in this place; to remove this, we are to consider that we have no particular account of the *British* coast (which might determine this question) older than *Julius Caesar*; whereas, this might have happened several hundreds of years before that time, when, tho' the island itself might be known to the *Greeks* and *Romans*, yet not its particular coastings: But the Dr. adds further, that *Plato* tells us a story (as of a thing which had happened some ages before his time, and which then, was in a manner generally forgotten) of an island somewhere in the *Atlantic Ocean*, which by a deluge, and earthquake, in the space of a night and day, was destroyed and swallowed up by the sea, whereby, that sea, formerly navigable, was for some time become dangerous; by reason of the mud, and reliques of that absorbed island; which seems to the Dr. very applicable to the rupture of this *Isthmus*, whereby,

whereby this island was not, indeed, entirely destroy'd, but was broken off from the continent, to which it was before united; and, upon such an accident, the sea must needs be disturbed, put out of its course, and rendered unsafe for passage, before it came to be settled again; for, tho' the first breach might be made in the space of one night and day, we cannot suppose the whole bulk of it, when once broken, to be presently carried quite away; but first the top, or upper part of it, in a day and night's time, and afterwards the lower parts thereof by degrees; which would render that sea, if not quite unpassable, yet dangerous at least; and, if in some circumstance, this narration happens to differ from the matter of fact; as calling the rupture of this *Isthmus*, the subversion of an island; this must be allowed in the narrative of an old tradition from hand to hand, for, as such, it is there brought in: *Plato* introduces *Critias*, then an old man, telling a story, which, when he was a boy of 10 years old, he had heard from his grandfather, who was 90 years of age, what *Solon*, long since dead, had told him; namely, that an *Egyptian* priest had, long before, told *Solon*, that it appeared from some old *Egyptian* records, of which the *Greeks* had no knowledge, that such a thing had happen'd, in an age so long before, that, in comparison, the *Greeks* were but as children; and all this tradition, thro' so many hands, and at such great intervals of time, is, at every step, reported from the relator's present memory; and it is very possible, that some one or other of these relators might so far mistake, or misremember, as to call that a dissolution or disappearance of an island, which was but a tearing of it from the continent: It serves, however, to the present purpose, if at least so much of the story be true, that long before *Plato's* time, there had been some such dissolution, or rupture of an isle or *Isthmus*, somewhere in the *Atlantic* ocean, that is, in the northern sea, of which there were some symptoms yet remaining in *Plato's* time; for, this being admitted, it is as applicable to the present case, as to any we know, of which there are so many symptoms yet remaining to this day; and tho' *Olaus Rudbec* in his *Atlantica*, cap. 7, sect. 8, p. 293, endeavours, in favour of his *Sueonia*, to put an allegorical sense upon all this passage; yet *Dr. Wallis* does not see, why, it may not be understood in a plain literal sense, as a true matter of fact, tho' perhaps a little disguised, as was the manner of that age, in relating old stories, and is very consistent with all that *Rudbec* cites out of *Plato*, in the said chapter of his *Atlantica*; for, the name of the *Atlantic* sea, wherein this island is said to be, was not then,

nor is it now, confined to the coast of *Sweden*, but extended as far as the *British* island, and much farther; and when *Rudbec* tells us out of *Plato*, that the whole *Atlantica* was as big as *Lybia* and *Asia*, which whether meant of either of them singly, as *Rudbec* understands it, or of both together, as the words seem to import, the Dr. will not contend: We cannot suppose it to be *Plato's* meaning, that this whole region was swallowed up, but rather some small part thereof, from whence, perhaps, the whole might take its denomination; and tho' he tells us from another author, that it was five days voyage from the *British* island, to that part of his *Atlantica*, where for 30 days together the sun does not set, this does not hinder, but that the *British* islands may be part of the *Atlantic* region, tho' so far distant from the utmost northern cape thereof.

Mr. *Somner* tells us, that this *Æstuary* from *Sandwich* to *Ashford*, might perhaps flow so much farther, as to meet with that *Æstuary* on *Romney-marsh*, and both being joined together, become one level; there is, the Dr. thinks, three or four miles distance, between *Ashford*, and the nearest part of *Romney-marsh*; and, if it be admitted, that the two *Æsturies* of *Stoure* and *Romney-marsh*, did thus meet in former times, this opens a new scheme, of which before we were not aware; for, then we must say, that the two tides from the north and west, which now meet at the *Dogger-sands*, did then meet at the confluence of these two *Æsturies*; and then, as was just now said of the *Dogger-sands*, bringing on both sides, soil, mud, and sand to this place, and lodging it there, might first form an *Isthmus* between *Dover* and *Calais*, and open a new passage, such as it is now; there are several other *Æsturies* in *England*, where the sea enters a great way into the land, and how far it might have enter'd in former times cannot be determined; as that sea by *Bristol*, between *Wales* and *Cornwal*; that of the *Humber*, between *Yorkshire* and *Lincolnshire*; and we may reasonably suppose, that the washes and fens in *Lincolnshire*, might heretofore have been sea, or overflow'd by the sea at high tides; and that of the *Thames* between *Kent* and *Essex*, which now flows above *London* and *Brentford*, within a mile of *Kingston* at spring-tides; it may perhaps seem too daring, to think that it formerly flow'd as far as *Oxford*, between *Shot-over-hill* and *Foxcomb-hill*, and so on towards *Wallingford*, in the time of the *Romans* called *Galena*; but there is this to countenance it, that there are frequently found, in our stone-quarries and gravel-pits about *Oxford*, fish-shells, and even the bodies of fish petrified, at great depths under

under ground; and there have been, no doubt, and there now are in *England* several other *Æstuaries*, creeks, or arms of the sea, entering a great way within the land, some whereof may, in a manner, be filled up, and become firm land; others, much narrower, shallower, and shorter, than they have been in former times; for, it is the nature of *Æstuaries*, where the tides flow in, to leave behind them, at their return, a deal of mud, ouse, or sleet, as they call it, which in time becomes firm land.

At *Hythe* in *Kent*, which is one of the *Cinque Ports*, there was formerly a convenient harbour for small vessels, which is now swarv'd up; several attempts have been made to recover the harbour, but with little success; for, when, with great labour and charge, they have in some measure open'd it, it has soon been filled up again, by what the sea casts up; and, whoever considers the vast quantity of, what they call, beach, that is, small loose stones and fish-shells, cast up by the sea, at *Hythe*, *Lyd*, and elsewhere on the coast of *Romney-marsh*, for several miles in length and breadth, and to a great depth, will not think it strange, that a creek, or *Æstuary*, should in time come to be filled up, and become firm land; and in several places, this beachy ground, where, nothing was to be seen, but such loose stones and shells to a great depth, comes, by degrees, to be cover'd with earth, and becomes pasture-ground: On the contrary, that what was formerly firm land, might be so destroy'd, or wash'd away, as to become sea, is evident from the *Goodwin-sands*, on the coast of *Kent*, which are said to have been the lands of *Earl Goodwin*, but lost by inundation, about the time that *Tenderden* steeple was built (which gave occasion to that ironical proverb of things co-temporary, that *Tenderden-steeple was the cause of Goodwin-sands*) the occasion of such different effects, depending on the different situation of the shores, and the setting of the tides, so as to wash off from one place, what it lodges on another: And many such alterations have, no doubt, happen'd on the face of the earth all the world over, of which we have no particular histories; for, the world was of a great age, before the writing of any history, except the bible; and who knows, but, that in former ages, there might have been, even amidst the *Alps*, large lakes, which, in process of time, by earthquakes, or other accidents, might have been drain'd of their water, and become fruitful valleys; of which, it is said, divers symptoms have been discover'd, even amidst the *Alps*, in later ages; and something of the like nature has happen'd in *Jamaica*, *Sicily*, and other places.

Trees found under Ground in Hatfield-chace; by Mr. Abraham de la Pryme. Phil. Trans. N^o 275. p. 980.

THE levels of *Hatfield-chace* in *Yorkshire*, were the largest chace of red deer that King *Charles I.* had in all *England*, containing in all above 180000 acres of land, about half of which was yearly drown'd with vast quantities of water; which being sold to one Sir *Cornelius Vermuiden*, a *Dutchman*, he at length effectually dischaced, drained, and reduced it, both to arable and pasture lands, at the expence of above 40000 *l.* In the soil of all, or greatest part of the said 180000 acres of land, whereof 90000 were drained, even in the bottom of the river *Ouse*, and of the adventitious soil of all *Marshland*, and round about by the skirts of the *Lincolnshire* wouds, as far as *Gainsborough*, *Bantry*, *Doncaster*, *Baln*, *Snaith*, and *Holden*, are found vast numbers of the roots and trunks of trees of all sizes, great and small; and of most species that this island either formerly did, or at present does produce; as pitch-trees, commonly call'd firs, oaks, birch, beech, yew, wirethorn, willow, ash, &c. the roots of all, or most of which stand in the soil in their natural position, as thick as ever they could grow, and the trunks of most of them lie by their proper roots; most of the large trees lie along about a yard from their roots (to which they belong'd, as appears very plainly both by their situation, and the sameness of the wood) with their tops commonly north-east; tho', indeed, the smaller trees lie almost every way, a-cross the former, some over, and others under them; the third part of all, which are pitch-trees, commonly call'd firs, are some of them 30 yards long and upwards, and sold for masts and keels of ships; there have been oaks found 20, 30, 35 yards long, yet wanting several yards at the small end; some of which have been sold at 4, 8, 10, and 15 *l.* a piece, which are as black as ebony, and very durable in any service they are put to; as for ash, it is commonly observed, that the constituent parts of their texture are so dissolved, that they are become as soft as earth, and are commonly cut in pieces by the workmen's spades, which, as soon as they are flung up into the open air, crumble into dust; but all the rest, even the willows themselves, which are softer than ash, preserve their substance and texture entire to this day; Mr. *de la Pryme* has seen pitch, or firr-trees, that as they lay along, after they had fallen, emitted large branches from their sides, which had grown up to the bulk and height of considerable trees.

It is very observable, and manifestly evident, that several of all those sorts of trees have been burnt; but especially, the pitch or fir-trees; some quite thro', and others all on one side; some have been found chopp'd and squar'd, others bored thro', and others half split with large wooden wedges, with stones therein, and broken ax-heads, somewhat resembling the figure of sacrificing-axes; and all this in such places, and at such depths, as could not be open'd, since the destruction of this forest, till the time of the drainage; near a large root, in the parish of *Hatfield*, were found eight or nine coins of some of the *Roman* Emperors, very much consumed and defaced; and it is very observable, that upon the confines of this low country between *Burningham* and *Brumby* in *Lincolnshire*, are several large hills of loose sand, under which, as they are yearly worn and blown away, are discovered several roots of large firs, with the marks of the ax as fresh upon them, as if they had been cut down but a few weeks, and this *Mr. de la Pryme* has often seen; hazle-nuts and acorns have been frequently found at the bottom of the soil of those levels and moors, and whole bushels of fir-tree apples, or cones, in large quantities together; and at the very bottom of a new river, or drain, almost 100 yards wide, and four or five miles long, were found old trees squar'd and cut, rails, stoups, bars, old links of chains, horse-heads, an old ax, somewhat like a battle-ax; two or three coins of the Emperor *Vespasian*, one of which *Mr. de la Pryme* saw with *Mr. Cornelius Lee* of *Hatfield*, having the Emperor's head upon one side, and on the reverse a spread eagle; but that which is more observable, is, that the very ground, at the bottom of the drain, was found in some places to lie in ridges and furrows, thereby plainly shewing that it had been plow'd and till'd in former days.

Mr. Edw. Canby told *Mr. de la Pryme*, that there was found under a large tree, in the parish of *Hatfield*, an old fashioned knife, with a haft of a very hard and black sort of wood, which had a cap of copper or brass on the one end, and a ring of the same metal on the other end, where the blade went in, which blade soon mouldering away, he got a new one put in the haft, with the following distich thereon,

*Ever since No's flood was I left,
My old blade is consumed, but this is the haft.*

The same gentleman also found an oak-tree within his moors, 40 yards long, 4 yards diameter at the great end, 3 yards and a foot

foot in the middle, and 2 yards at the smaller end; so that, by a moderate computation, the tree seem'd to be twice as long; and for it he was profer'd 20*l*. At another time, he found a fir-tree 36 yards long, besides the computed length thereof, which might well be 15 yards more, so that there have been exceeding large trees in these levels; and what is also very strange, is, that there was found, at the very bottom of a turf-pit, a man lying along, with his head upon his arm, as in a common posture of sleep, whose skin being tann'd, as it were, by the moor water, preserv'd his shape entirely, but his flesh, and most of his bones were consumed.

To illustrate and render more intelligible this strange subject of subterraneous trees, let us see what has been observed in other places and countries; *Cambden*, and others, have told us, and it is a very common and well-known thing, that most of the great morasses, mosses, fens, and bogs in *Somersetshire*, *Cheshire*, *Lancashire*, *Westmoreland*, *Yorkshire*, *Staffordshire*, *Lincolnshire*, and other counties in *England*, are full of the roots and trunks of large trees, most of which are pitch or fir; and that they have the same positions and impressions of the fire and ax upon them, that those, already mentioned, have: *Giraldus Cambrensis* tells us, that in King *Henry II*'s days, by the violence of excessive storms, the lands were so much driven off the sea-shore in *Pembrokeshire*, that under them were discovered great numbers of roots and trunks of trees in their natural positions, with the impressions of the ax, as fresh upon them, as if they had been cut down but yesterday, with a very black soil, and some blocks like ebony; and the like were discovered also at *Neugal* in the same county, in 1590, and in *Cardiganshire* and other places since; *Dr. Plot* mentions the like roots and trees, found in *Shebben-pool*, the old *Pewit-pool*, and at *Layton*, and other places in *Staffordshire*; and from their natural situations he rightly concludes, that they certainly grew there: *Dr. Leigh*, in his history of *Cheshire*, observes, that in draining *Martin Meer*, there was found great numbers of the roots and trunks of large pitch-trees, in their natural positions, with great quantities of their cones, and eight canoes, such as the old *Britons* sail'd in; and in another moor, was found a brass-kettle, beads of amber, a small mill-stone, the head of an *Hippopotamus*, and human bodies entire and uncorrupted, as to outward appearance: Several places of the soil of the isles of *Anglesea* and *Man*, as also of the bogs of *Ireland*, are likewise full of roots and trees; *Verstegan* tells us, that in several places of the moors and morasses of the *Netherlands*,

herlands, large fir-trees are commonly found, with their tops lying to the north-east, just as they do in the levels of *Hatfield-chace*; and *Helmont* mentions the *Peel* there, a moss nine miles broad; *M. de la Ferr* says, that trees and roots are frequently found in the low grounds, levels, and morasses of *France*, *Switzerland*, and *Savoy*; and lastly, *Rammazzini* assures us, that in the territories of *Modena*, which are several miles long and broad, and at present a most fruitful dry country, tho' in the time of the *Cæsars*, it was nothing but a great lake, are found at 30, 40, and 50 foot deep, the soil of a low marshy country, full of sedge, reeds, shrubs, roots, trees, nuts, ears of corn, leaves of trees, branches and boughs of oaks, elms, walnuts, ashes, willows, and the very trees themselves, some broken, some whole, some standing upright, some lying at their length, &c. with old coins of the *Roman Emperors*, old marbles and stones squared, cut, carved, and wrought, &c. Most men refer all this to *Noah's flood*; but if so, how comes it, that the trees and their roots lie so near each other, and why lengthwise, from south-west to north-east? Why some of them burnt, others chopped, some split, others squared, and others bored thro'? Why does the soil at the very bottom of a large river lie in ridges and furrows? And why are the coins of *Roman Emperors* found there? But *Mr. de la Pryme* is of opinion, that all these trees grew in the very places, where we now find them, both here, and elsewhere; against which *M. de la Pryme* knows but of two objections.

1. That *Cæsar* expressly says, that no fir-trees grew in his time in *Britain*; but that *Cæsar* might have been mistaken in this point, may appear from what he mentions of the next tree, the beech; which he also excludes, tho' it is so very common in every part of this kingdom; and, in an old deed relating to this very chace, fir-trees or bushes are mention'd, as growing here and there, about 300 years ago; and it is very well known, that there was a tree of the very same wood growing upon *Hatfield-moor* side within these 30 years, which was cut down some time after, it being the very last of that kind, that was seen flourishing here.
2. The second objection is, that those sorts of trees grow always on high mountains and rocks, and never thrive upon such low grounds and morasses as these are, where we now find them; but, tho' they do, indeed, in all the cold countries of the north, thrive best upon the hardest rocks and mountains, yet are they sometimes seen even there, large and in great plenty, in the low morasses of *Liesland*, *Courland*, *Pomerania*, and other countries thereabouts; and in the low forests

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to the westward of *New England*; these trees require a sandy soil, and if it lie never so high, or never so low, they will grow there, and there it is natural for them; and it was observed, in digging a pit of a great decoy in these levels, that the roots of the firs always stood in the sand, and the oaks in the clay, as also in several other places of these commons.

The reason why all these woods were destroy'd, we may learn from the *Roman* historians, who frequently tells us, that when their armies and generals pursued the wild *Britons*, they always fled into the fastnesses of miry woods and low watry forests; *Cæsar* himself tells the same, and says, that *Cassibelan*, and his *Britons*, after their defeat, passed the *Thames*; and fled into such low morasses and woods, that there was no possibility of following them; we also find, that the stout nation of the *Silures* did the same, when they were set upon by *Ostorius* and *Agri-cola*; and so did *Venutius*, King of the *Brigantes*; who fled into the great woody morasses of this country, and, perhaps, into the very same that formerly overspread these levels; and *Herodian* tells us, that it was the custom of the wild *Britons* to keep in the fenny bogs and thick marshy woods, and when opportunity offer'd, to sally out, and fall upon the *Romans*; who were at length so gall'd with them, that they were forc'd to issue out orders for the destroying and cutting down all the woods and forests in *Britain*; especially all those that grew upon low grounds and morasses; this order is mention'd in *Vopiscus*; and that they were thereupon accordingly cut down, is evident from several authors, who tell us, that when *Suetonius Paulinus* conquer'd *Anglesea*, he cut down all the woods there; *Galen* tells us, that the *Romans* kept their soldiers continually employ'd in cutting down woods, draining marshes and fens, and paving bogs; it is also manifest, that they did not only do this themselves, but also impos'd the same task upon the *Britons*; for, *Galgacus*, in his speech to his soldiers, tells them, that the *Romans* made slaves of them, and wore out their bodies in cutting down woods, and cleansing bogs, amidst a thousand stripes and indignities; and *Dion Cassius* tells us, that the Emperor *Severus* lost 50000 of his men in a few years time, in cutting down the woods, and cleansing the fens and morasses of the country.

As *Mr. de la Pryme* has shewn in general, that the *Romans* destroy'd those great woods and forests; so now he comes to shew in particular, that they actually were in this part of the country, and destroyed this large and beautiful forest of

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Hatfield-chace; the common road of the *Romans* out of the south, into the north parts of the country, was formerly from *Lindum* or *Lincoln*, to *Segelocum*, or *Little Burrow* upon *Trent*, and from thence to *Danum* or *Doncaster*, where they kept a standing garrison of *Crispinian* horse; a little off to the east and north-east of this road, between the two last nam'd towns, lay the borders of the large forest, which swarm'd with wild *Britons*, who were continually sallying out, and retreating into it again, intercepting the *Romans* provisions, taking and destroying their carriages, killing their allies and passengers, and disturbing their garrisons, which at length so enraged the *Romans*, that they were resolved to destroy it; and that they might do it the more effectually, they marched with a great army, and encamp'd upon a spacious heath, or moor, not far from *Finningly* (as appears by their fortifications still to be seen there) where it is probable that a great battle ensued, for hard by, is a little town, called *Osterfield*; now, as the latter part of the word is never added to any other, but where there has been a battle fought, so, the former seems to inform us what *Roman* general it was, who commanded; to wit, the famous *Ostorius*, who, all the *Roman* historians assure us, had been in those parts; but who got the victory is not so easy to be judged, tho' no doubt it was the valiant *Romans*, who, besides the great numbers of *Britons* they slew, drove the rest back into the great forest and wood, that covered all this low country; whereupon, the *Romans*, that they might destroy both it and the enemy the easier, took the opportunity of a strong south-west wind, and set large fires therein, which taking hold of the fir-trees, burnt like pitch, and consumed vast numbers of them; then, when the fir had done what mischief and execution it could, the *Romans* drew their army nearer, and with whole legions of captive *Britons* felled most of the trees that were still standing, leaving only here and there some large ones untouch'd, as monuments of their fury; which being destitute of the support of the under-wood, and of the neighbouring trees, were easily overthrown by the strong wind; all which trees falling cross the rivers, that formerly ran thro' this low country, soon damm'd up the same, turned it into a great lake, and gave origin to the great turf-moors that are here, by the windings and workings of the waters, the precipitation of terrestrial matter therefrom, the consumption and putrefaction of rotten boughs and branches, and the vast increase of thick moss-water, which wonderfully flourishes, and grows upon such rotten grounds; which, even now since the drainage, and since the country for several miles round has been laid dry, yet for all

that, are so turgid with water, and so soft and rotten, that they will scarcely bear men to walk upon them; hence it is, that old *Roman* coins, old *Roman* ax-heads, &c. have been found by those roots and trees, that lie at the bottom of these moors and levels; hence it is, that in all these grounds are found great numbers of trees, that are burnt some in two, and others lengthwise, and some hew'd and chopp'd; hence it is, that they lie by their own proper roots, with their tops north-east; hence it is, that they lie by their own proper roots, with their tops north-east; hence it is, that some of the largest trees are found with their roots on, and others, as they have laid all along, have had branches growing out of their sides, to the bulk and height of considerable trees; hence it is, that both the clay and moor-soil of the country is in some places two or three yards higher, than it was formerly by the growing up of the same, and the daily warp that the rivers cast continually thereon, &c.

As the *Romans* were the destroyers of this great forest, so were they likewise of all those others, that formerly grew upon the low-lands of *Cheshire*, *Lancashire*, *Yorkshire*, *Lincolnshire*, *Staffordshire*, *Somersetshire*, &c. and of the countries before-mentioned beyond sea, where such trees are found; but, as the *Romans* were not much in *Wales*, the *Isle of Man*, or *Ireland*, so it cannot be supposed that they cut down their woods; but, yet others did, for *Hollingshead*, and others of our historians, tell us, that *Edward I.* not being able to get near the *Welch* to fight them, by their staying and skulking in the boggy woods, commanded them all to be destroy'd by fire and ax; and, *Mr. de la Pryme* does not at all question, but that the trees and roots, before-mention'd by *Cambrensis* in *Pembrokeshire* were the relicts of some of those that were then destroy'd; and as for those in the *Isle of Man*, and other islands, they all have been cut down in time of war, and have lain, till they were grown over with the soil of the neighbouring grounds; and as for those found in the bogs of *Ireland*, several of our historians expressly say, that *Henry II.* when he conquer'd it, cut down all the woods that grew upon the low grounds thereof, the better to secure his conquest and possession of the same, to keep the country in a settled peace, and to disarm the enemy, who commonly trusting to such advantages, are apt to rebel; *Mr. de la Pryme* further adds; that it is a very common thing for generals, even to this very day, to destroy all the woods that grow upon advantageous places, and fastnesses in an enemy's country, if they intend to keep it, and that they always do it with fire and ax.

A Child with the Intestines, &c. in the Thorax; by Sir Charles Holt. Phil. Trans. N^o 275. p. 992.

THIS child having died about two months old, they gave the following account of its sickness; that it was uneasy and restless from its birth, and constantly laboured under a difficulty of breathing; that its illness was nothing like what they had seen in other children; nor could they perceive it reliev'd by any thing administred to it, tho' by the advice of a skilful physician; but it lay groaning and pining till it died; that they had always observ'd, when the child was undressed, an odd sort of working in its breast; and could perceive a crawling round the ribs and breast on both sides, as if a knot of small eels, or large earth-worms, had been pent up within its cavity.

Upon opening the *Abdomen* there appear'd none of the *Viscera* belonging to the belly, excepting the liver, kidneys, *Vesica urinaria*, and *Intestinum rectum*; we at first imagined that the other intestines might be cover'd by the liver, which (tho' commonly large in children) here exceeded the usual size; but, upon turning it up towards the diaphragm, we only found under its concave part, the stomach, not lying in its natural position, for the *Pylorus* was drawn by the *Duodenum* cross the *Vertebrae* of the back towards the bottom of the ventricle, and part of the *Duodenum* pass'd thro' a *Foramen* in the diaphragm, placed on the left side of that, thro' which the *Gula* descends, which occasioned the *Pylorus* to lie almost under the *Fundus ventriculi*; we then resolv'd to trace the *Rectum* from the *Anus* upwards, not doubting, but that it would lead us to the *Mesentery* and intestines; the *Rectum* lay in an oblique line from the *Anus* to this new *Foramen*, and was received into it with a portion of the *Duodenum*; this *Foramen* seem'd to be form'd by nature, from the child's first formation for transmitting those guts into the *Thorax*; for had it been made by any force, its sides would have appear'd wounded, or lacerated; but on the contrary, round this orifice, there was a round verge, as is seen in the pervious *Foramen* of the *Vena Cava*, or that, by which the *Gula* descends; when we took off the *Sternum*, we saw the *Mesentery* with the intestines in the cavity of the *Thorax*, lying upon the heart and lungs; there was no *Omentum* spread over the intestines, which was entirely wanting, as was likewise the *Mediastinum*; most part of the *Duodenum* lay in the *Thorax*, and all the rest of the guts excepting the *Rectum*, which

ascended in an oblique line from the *Anus*, and its upper part was inserted into this orifice; we then began to consider, how this child, according to the common notions of nutrition, could be nourished; that it was nourished, seems plain, because it daily received food, and regularly voided the *Fæces*; so we proposed to enquire what communication there was between that gland, or glands, in the middle of the mesentery (commonly called *Pancreas Asellii*) and the *Receptaculum Chyli* placed between the internal lumber muscles, called *Psoas*; but upon the most accurate search, there was none to be found; for the whole meseraic membrane, and intestines, lay perfectly loose upon the heart, and lungs, absolutely disengaged from any other part; that vermicular motion, which shewed itself on the ribs and breast, we ascribed to the peristaltic motion of the guts; and the *Dyspnœa*, or difficulty of breathing, we thought might be occasioned by the pressure made upon the lungs by the intestines and mesentery, which likewise so filled up the *Thorax*, that there wanted room for the lobes of the lungs to move freely in, and consequently, inspiration and expiration were performed with difficulty.

Plate III. Fig. 1. *a* shews the *Foramen*, thro' which the *Vena Cava* passes; *b* the *Foramen*, thro' which the *Gula* descends; *c* the *Foramen*, thro' which part of the *Rectum* and *Duodenum* went into the *Thorax*.

A further Account of a Disease caus'd by swallowing Pebble-stones; by the same. Phil. Transf. N^o 275. P. 995.

GOBBSIL (whose case is in Phil. Transf. N^o 253.) came to Sir Charles Holt, and told him the pebble-stones grew very troublesome to him, that of late he had vomited up two of them, which Sir Charles caused to be weighed, and found one to weigh two drachms, and the other one drachm two scruples and a half; the patient complain'd that his strength was of late much impair'd; that he voided great quantities of blood by stool, which kept him very weak; his appetite was much impair'd, and would retain scarce any thing; his hands were paralytic, always extremely cold, and his fingers contracted; he was not able to open them without help, nor could he keep them so, unless it was by force; his legs were very likely in a short time, to be as useless to him, as his hands; for, he said, they began to fail him, and in the same manner to grow cold, and have little feeling in them; but, the most remarkable of all his
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complaints, was, a new progress, the stones had either found, or made; formerly at night in bed, they used to get up, as he express'd it, to his heart, and upon turning to his knees, or standing upright upon his legs, they would drop one by one so distinctly, that they might be counted, and in this state, they always arose streight up, on the right side of his breast; but now, they rose obliquely, and got under his right arm, inclining towards the *Scapula*, and when they were in this place, by giving him a blow with the fist on his right shoulder, they would all fall down in a lump together, and might very plainly be heard to clash on the other stones, which lay, as they did formerly, just above the *Os Pubis*; the matter of fact prov'd true as he related it, Sir *Charles* having made the experiment before Drs. *Fowke* and *Davies*.

Powder'd Blue *passing the Lacteal Vessels*; by Dr. W. Musgrave. Phil. Trans. N° 275. p. 996.

TO account for fevers, and the obstruction of the glands, (from which most, if not all fevers proceed) we must admit of crude, and otherwise vitiated chyle, as well, if not oftener, than the external accidents from cold and heat, and the disorderly temperature of the air; which appears from Dr. *Lister's* experiment, afterwards confirm'd by Dr. *Musgrave*, viz. that a dog kept long fasting, would not only admit into the lacteals a tinctur'd liquor, but a very substantial one, such as powder'd blue.

Dr. *Musgrave* injected into the *Jejunum* of a dog that had but little food for a day before, about twelve ounces of a solution of indigo in fountain water; and three hours after, opening the dog a second time, he observ'd several of the lacteals of a blueish colour; which, upon stretching of the mesentery, did several times disappear; but was most easily discern'd, when the mesentery lay loose, which is an argument that the blueish colour was not properly of the vessel, but of the liquor contain'd therein: A few days afterwards, repeating the experiment, in another company, with the solution of stone-blue in fountain-water, and on a dog kept fasting 36 hours; he saw several of the lacteals become of a perfect blue colour, within a very few minutes after the injection; for, they appear'd so, before the Dr. could sew up the gut: Afterwards, having kept a spaniel fasting 36 hours, and then syringing a pint of a deep decoction of stone-blue with common water, into one of the small guts, and three hours afterwards, opening the

the dog again, he saw several of the lacteals of a deep blue colour, and upon cutting them, they afforded a blue liquor, viz. some of the decoction, running forth on the mesentery; after this the Dr. examined the *Ductus thoracicus*, on which, together with other vessels near it, he had upon his return, made a ligature, and he saw the *Receptaculum chyli*, and that duct, of a blueish colour, not so blue, indeed, as the lacteals, from the solution mixing with *Lympha*, in the *Receptaculum* and near it; but much bluer than the duct uses to be, or the lymphatics under the liver (with which he compared them) were: In each of these experiments, the Dr. had the assistance of several physicians, who all agreed with him, as to the colouring the lacteals.

The entrance into the lacteals (which is much the narrowest part of all the passages from the mouth to the mass of blood) being thus prov'd, beyond exception, to be wide enough to admit so gross a body, as stone-blue, we may here in part explain the admission of liquors, as of diuteric waters, &c. into the vessels in great quantities, and that in a very little time; the same wideness of the lacteals makes them ready to receive those grosser bodies, convey'd in proper vehicles, which afterwards compose the grumous part of the blood, the cartilages, and bones; and this open entrance being allow'd, it will no longer seem impossible, that with our nourishment, eggs, or, *Animalcula* themselves, should enter these vessels; there being no manner of question, but that of both the one, and the other, some are much less in bulk, than the greatest particles of indigo, in the decoction above mention'd, seen in the lacteals; besides, the several other species there are of small insects, and their great fertility; when we consider, how numerous and various those of the animal kingdom are, that a very small proportion, perhaps not a quarter part, comes within the view of the naked eye, then, we shall be the better enabled to account for the great variety, as well as numbers of insects, observ'd in the juices of the animal body: But, the chiefest use of the wideness of the lacteal orifices, is, in deducing from thence the reception of gross matter, such as are the effects of indigestion, &c. which afterwards in the blood and *Genus Nervosum*, many times produce severe distempers, which notion, in some degree, was confirmed by its first proposer Dr. Lister, in *Exercit. altera de Pontibus medicatis Angliæ Edit. Lond. p. 48.*

An Account of the greatest Part of a Fœtus voided by the Navel; by Mr. C. Birbeck. Phil. Trans. N° 275. p. 1000.

THE wife of one *Raper* at *Coxwold* 12 miles from *York*, falling in labour, the midwife extracted the *Secundines*, which offer'd first, but could not by her best skill perceive any thing else remaining; the woman's body falling, and she being pretty easy for some days, and the *Uterus* being contracted, the midwife took these *Secundines* for a *Mola*, or false conception; but in a week more the patient began to discharge plenty of foetid matter by the *Vagina*, which continued, and in process of time she felt a troublesome hardness on the *Hypogastrium*, which increased daily for above six weeks; by which the patient was brought so low, that they despair'd of her life; this lump, hardness, and soreness wrought upwards to the umbilical region, and continued fixed there, for about a month; at length, being exceeding painful, the neighbouring women took it for a great boil or imposthume, and applied what they usually do in such cases, to assist its suppuration, and breaking, which had its effect, and it broke upon, or rather under the navel, and then afterwards discharged a great quantity of a thin, foetid, and discoloured liquor; the parts about it mortified, and the ulcer enlarged to that bigness, that a man's hand might be introduced therein; it continued exceeding painful, and emitted such a noisome stench, that none could endure to look upon it; some short time after, they found some little bones wrought out of it, which being shew'd Mr. *Birbeck*, he found them to be the bones of a child's finger; upon which he went to see her; when he had examined the place, he perceived the *Fœtus* lie in a confused heap, or mortified lump, for, with his probe he felt several bones, and at that time extracted (after separating and dilating the mortification about it) above half the ribs, some of the *Vertebrae* of the back, and other bones, and cut out above a pound of the child's mortified substance, as black as ink, with an exceeding nauseous stench; and every 2d or 3d day for a month, he extracted what he could, being obliged to do it very deliberately, by reason of the exceeding weakness of the patient, who would have certainly died under the operation, had he forcibly extracted it, and not given her time; for, we were obliged every moment to support her with cordials, and after each operation, she found herself lightsomer, and by degrees sweeter, which gave
Mr.

Mr. *Birbeck* hopes of her recovery; for, not only the *Lined alba*, and the muscles of the *Abdomen*, but the *Peritonæum* and *Omentum* were mortified to a great breadth, and the intestines lay fairly in view, and exposed to the air for a long time; after extracting part, and having a plentiful discharge of thin fœtid matter, the discharge downwards began to lessen and abate, so, that he endeavoured to assist it by bandages and compresses, with deterging and drying injections up the *Vagina*; by which means in a little time there was no discharge that way, and those parts soon became perfectly well; and in some time after, the ulcer separated (with the assistance of fomentations, good digestives, and mundificatives) from its putrifaction, the part contracted and united; and had now been quite cicatrized near three months, all the *Abdomen* being soft, easy, and well condition'd; the patient laboured all the season at hay-harvest: Mr. *Birbeck* supposes, that by the forcible extraction of the *Secundines*, the *Uterus* had been lacerated, and this occasion'd the ulceration; and the patient being extremely weak, and constantly lying a-bed, gave the more liberty for its working upwards.

Asbestus, &c. found in Scotland; by Mr. Wilson. Phil. Trans. N° 276. p. 1001.

IN the grounds of Mr. *Gordon* of *Achindore*, in the shire of *Aberdeen*, near the *Highlands*, on the side of a hill of a heathy kind of soil, somewhat inclining to what we call moss; in a very small brook, and also hard by it, for 10 or 12 yards, Mr. *Wilson* found a great many stones, some a foot long, which plainly appeared like wood; but because he could not perceive any vestige of wood thereabouts, and because none of the stones could be found, but in that spot of ground only, he could not think they were petrified wood; then upon cutting up the ground about that place with a knife, he found some pieces of the stone, and very near the surface several pieces of a fibrous substance, which his knife could not cut, upon which, he immediately judged this was an incombustible matter, as it proved afterwards, when he tried it in the fire; when he found some pieces of the stone very hard in the middle, and the fibrous substance, or filaments on the outside and extremities, he was inclined to think that the flax came from the stone; but then finding several pieces of the flax so condensed, that at first they appeared to be hard stones; but being a little wetted, the filaments were easily separated from each other; he found several, more or less condensed like a stone, and all of it, both that

that which was condensed together, and that which was not, lay about an inch within the ground, parallel with the surface, and so interwoven with the fibres of the grass-roots, without any root of its own, but a-like at both extremities, as if cut with a knife, that it seemed to Mr. *Wilson* much more probable, that the flax turned into stone, than that the stone turned into flax; especially, since most part of the stones appeared so tender, and brittle on the outside, that it is difficult to conceive, how they could turn into that tough substance of flax: The stones are of different sorts, some are white, of the colour of the flax, and of a very soft substance, so that they may be easily cut with a knife; others are much mixed with a whitish *Talc*; but most of them are of a greyish colour, and very hard; the soil wherein it is found, is of a greyish colour, about an inch or two thick, under which, there is a black soil a foot deep; so that he could find nothing in the places, where most of it was got, from which, he could rationally conclude, it was produced; but in some other spots, he found a deal of *Talcish* sand, with some pieces of flax near it; as also some pieces of the stone much whiter than the rest, and very like *Talc*, from which it is probable it was produced; yet there being no appearance of any *Talc* in the other places, where most of it was found, he could scarcely conclude any thing about its production.

Pliny, *Aldrovandus*, & *Olaus Wormius* make *Asbestus* to be very short, whereas some of what Mr. *Wilson* found was 5, 6, 7 and some 8 inches long; as for the making of it into cloth, they all conclude it very difficult; yet it may be seen, by an experiment of Mr. *Wilson's* in making yarn of it, that cloth may also be made thereof; for the difficulty is much greater in the one, than in the other.

The strange Bones and the Isthmus between Dover and Calais further considered; by Dr. Wallis. Phil. Trans. N° 276. p. 1022.

MR. *Luffkin* supposing in (Phil. Trans. N° 274.) that the large bones found in a gravel-pit, near *Harwich*, much like those found at *Chartham*, were rather those of an elephant, than of an *Hippopotamus*, or other marine animal; Dr. *Wallis* thinks, which soever it is, that it will equally prove those valleys to have been much deeper in former times, than now; the Dr. observes, that the river in *Essex*, and that in *Kent*, near which the bones were found, are both of them

called the *Stoure*, which, whether it be a corruption of the *Latin Æstuarium*, as Mr. *Sommer* conjectures, or of the *Bri-
tish* *ys-dwr*, that is, the water, the Dr. will not dispute; and, that the bones, being found, in both places, much at the same depth, *viz.* 16 or 17 foot, might probably have been lodged in both, much about the same time; and that, perhaps, when the emperor *Claudius* brought his elephants into *Kent* and *Essex*, as Mr. *Luffkin* intimates out of *Dion Cassius*; the Dr. also observes, that those petrified bones, in both places, were found in gravelly soils, as are those petrified shells, and bodies of fish, in gravel-pits and stone-quarries near *Oxford*; how far the steams, fumes, or fluors of the earth, which contribute to the formation of stone, or gravel, might conduce to the petrifying of these bones, shells, or other bodies, he leaves to the consideration of naturalists; and, whether the impregnation of such steams might not swell such petrified bodies, to a larger proportion, than they had before; just as we observe wood, and other like matter, to swell in a moist air, by the distension of their pores, upon the intermission of moist particles; for, the Dr. takes all petrifications to be caused, either by incrustation, or the intromission of stony particles; and he observed at *Moldash* in *Kent*, near *Fever-sham*, on some high grounds, very stony, (which sometimes used to be pasture, and sometimes plough'd-land) divers oyster-shells petrified, or partly so, much larger, and thicker, than the ordinary proportion of oysters in those parts, and very weighty; which oyster-shells might have been purposely thrown there long before, as being reputed a good manure, and might have been impregnated with the like halitus, and effluvia, as are the numerous stones on those lands.

But to return, the Dr. does not see, why, we may not suppose, the *Stoure* in *Essex*, and the *Stoure* in *Kent*, to have been, both of them, *Æstuaries* of the northern tide, before the rupture of that *Isthmus* between *Dover* and *Calais*; and the like, of the river near *Malden*, and other small creeks on the coast, tho' not so large as those of the *Humber*, and the *Thames*, which were then *Æstuaries* of the same sea, as are many others on the coast of *Scotland*; the Dr. says before that rupture; for, since that rupture, the case, as to the *Thames*, is somewhat altered; for, the western tide between us, and *France*, which was then stopped at this *Isthmus*, does now flow on thro' that *Fretum*, beyond the mouth of the *Thames*, as high as the *Dogger-sands*; which therefore, supplies the *Æstuary*

ary of the *Thames*, which was formerly furnished from the northern sea; and these smaller *Æstuaries* might sooner be choak'd up, by what every tide lodged there, while those larger *Æstuaries* are but shortened, and become narrower than they had formerly been; and, as to the *Thames* in particular, it seems very evident, if we consider their situation and the nature of the soil, that much of the low grounds in *Kent*, and *Essex*, on both sides of the *Thames* mouth, adjacent to the sea, had formerly been sea, as well as that of *Romney-marsh*; and when the mouth of the *Thames* was so much wider, no doubt, but the sea flowed much farther than now it does, but how far, no one can determine.

It may, perhaps, be objected, that the little rivers still remaining in the bottom of these valleys, which may be supposed to have been *Æstuaries* in former times, do now run with more windings and turnings, than these valleys themselves do; but this need not at all seem strange, when we may daily observe the same, in the bottom of a muddy ditch, or water-course, when the water is almost drained off, the mud still remaining soft; that the little water, which is left, will work out for itself amidst the mud, a winding passage (according as the mud will give it way more or less, much more crooked than the ditch itself when full of water; and the like must needs happen in the gradual draining of such *Æstuaries*, according as the soft soil will permit; which curvity will still continue, when the banks on both sides do by degrees become firmer: As to what the Dr. observed concerning the isle of *Oxney*; a low level in that isle, which had for several years lain under water, is now raised by introducing the tide, to a considerable height above what it was formerly; and the channel from thence to *Rye*, is, by the tides flux and reflux, become much wider and deeper than heretofore: If we look in the more ancient maps of *Kent* before the year 1640, we shall find, that what we call the isle of *Oxney*, was then but a *Peninsula*, being continued (by a small *Isthmus* at the north-east corner thereof) to the rest of the country; and the tide from *Rye* to that place, which now flows streight on by the north-side of the isle, was there stopped by that *Isthmus*, and wheel'd about on the south-side thereof; or rather, the river *Rother*, did from the north-side of the island, wheel about by the south-side to that eastern corner, and thence by the channel to *Rye*; while things were in this state, divers moorish or marsh-

lands adjoining to the river *Rother*, were often in danger, upon great rains, of being overflowed; but so it happened once, that this drown'd land had unexpectedly, in one night's time, or more, discharged itself on another level somewhat lower; upon which indication it was thought advisable, by cutting that *Isthmus*, to allow those waters on the north-side of the island a straiter passage towards *Rye*; and to let those lower grounds lie for some time under water, till by introducing the tide, they might be somewhat heightened, and then timely recovered.

Of the Invention and Improvements of the Mariners Compass; by the Same. Phil. Trans. N^o 276. p. 1035 and 1106.

DR. Wallis is of opinion, that the mariners compass was originally an *English* invention; not only, because the *English* have been of old as famous for navigation, as any other nation, long before the *Holland* sea-trade was in being, and a long time after; but (since new inventions commonly take their names from the place where they are made) from the name compass; which is an ancient *English* word, for what we otherwise call at this time a circle: In *Kent* it was commonly used in that sense, when he was a youth; and *Minsheu* in his dictionary takes circle, and compass, indifferently to signify the same with *Circulus*; and hence it is, that *Circinus* is in *English* called a compass, or pair of compasses, as being the instrument wherewith we describe a compass or circle; but whether *Circinus*, called by us a pair of compasses, may have some such name in another language, or how anciently, the Dr. does not know; nor can he determine, whether the word compass, or any word like it, was ever used in any other language for a circle indefinitely, or for any other circle, than the *Circulus nauticus*; in *French* it is *Cercle*, in *Italian* *Cerchio*, in *Spanish* *Circulo*, or some other word derived from the *Latin* *Circulus*; and from hence the *Circulus nauticus* may come to be called the mariners compass, which name being given it by the first inventors, might give occasion for the like names in other languages, *French*, *Italian*, *German*, &c. compass, *Compasso* *Zee-compass*, &c. which name, together with the art, the Dr. conjectures they borrowed from *England*: He might, he says, urge the same thing from another name, *Bossolo*, *Bossola*, &c. For, as *Circulus nauticus* is the mariners compass, so *Pyxis nautica*, is the mariners box, for the *English* word *Box* is from the *Latin* *Pyxis*, and *Pyxidula*, as a diminutive from *Pyxis*,
must

must be *Boxel*, or some word like it, which easily passes into the *French Buxole*, *Bouffole*, and the *Italian Boffola*, *Bouffula*; all which seemed to be derived from the *English Boxel*, *Pyxidula*, or a little box, softening the sound of the letter *x* into *ff*, as in *Alessandro* for *Alexandro*: All which tho' it be not a direct demonstration, yet (since it is not agreed by whom, or where the compass was invented) may in the silence of history be admitted as a probable conjecture, and a plausible pretence to the invention, till a better claim appears; and where inventions creep in by degrees, it must not be thought strange, if it be not easy to say who is the first inventor: In the present case, he who first observed that the magnet had a polarity, or inclination northward, made the first step towards this invention: This was at first wont to be shewed, by putting a magnet into a little boat, swimming on water, when it was observed, that this magnet would of itself so steer this little boat, as that a certain point of the magnet would (if not hindered) turn towards the north; which point was thereupon called the magnet's north pole; he that afterwards observed, that this verticity, or polarity, was communicable to a piece of iron, or steel, rubbed on a magnet, added a further step; and he who contrived a way to set a needle, or piece of steel, so touched on a sharp pin, as in the air to move horizontally thereon, and of itself find out the north, and point towards it, as the swimming magnet had done before in its boat on the water, had now discovered a new experiment in natural philosophy, very surprising; but this cannot yet be called *Circulus nauticus*, or the mariners compass, till they had further contrived, how to put a needle thus poised into a box, with a compass or circle round it, divided in such a manner, as to denote the azimuthal points of the horizon, or as they are now called, the points of the compass; and commodiously fix this box so prepared, to the ship, as thereby to instruct the mariner, or steersman towards what point of the compass the ship moved; that by the help of the rudder he might put it into such a course, as was proper for his voyage; and it was now, indeed, *Pyxis nautica*, or *Circulus nauticus*, the mariners box, or compass, but not till then; and he who first contrived this application, did complete the mariners compass; but all those antecedent discoveries were steps towards it, and part of the invention: Now it is not likely, that all these discoveries were made at once, by the same man, at the same time, but successively

cessively, by the joint advice of divers inquisitive men, and in a considerable tract of time; yet all perhaps, of the same nation, and probably the *English*: But, whoever gave the first hint of this invention, certain it is, that the great improvements of the magnetic doctrine are due to the *English*, and chiefly to those about *London*, and *Gresham College*.

The case is much the same with the art of printing, which we cannot reasonably suppose to be invented all at once, nor perhaps all by the same man; but rather by several concurrent hands, and in a considerable tract of time, before it came to that degree of perfection, to which it is now arrived: It might be first observed, that the shape of a letter, figure, or picture, graved on wood, or metal, might by the help of a convenient preparation of oil, ink, or coloured liquor, be stamped on paper; and if once, then as often as you please; but, this being admitted, it remains further to be contrived, how several types, or stamps for a whole page shall be so composed into one frame, that the paper may be applied to all at once; it is then to be considered further, what kind of ink, is to be applied to the face of the letters, thus composed; for, common writing-ink will not serve the turn; then how the paper shall be applied, with an equal and sufficient pressure, so as to take off just so much of that ink, as represents the figure of those letters, and no more; and after all this, it must be further contrived, how to erect such a machine, as what we now call a printing-press, and how to manage it, so as to answer all these exigencies; for till all this be done, we are not arrived to what we call printing; yet these previous contrivances must be owned as parts of the invention; and thus it is likewise in the doctrine of magnetism; and to those previous discoveries, must be added the subsequent improvements made therein, since the first use of the mariners compass, of which whoever was the first inventor, it is certain, that the doctrine of the magnet has received very great improvements from the *English*, viz. *Blagrave*, *Gunter*, *Gellibrand*, *Gilbert*, *Norwood*, *Wright*, *Briggs*, *Foster*, &c. as also from Captain *Halley* in his map of the magnetic variations, which are thereby fixed in those seas for the present time.

The Dr. takes it to be agreed on by all, that what we call the variation of the needle, is an *English* discovery, viz. of Mr. *Gellibrand*, one of the professors at *Gresham College*, about the year 1625; that is, that the magnetic needle in its horizontal

zontal position does not retain the same declination, or variation from the true north, in the same place, at all times, but varies successively that declination from time to time; which, tho' it was about that time, a new discovery, is now admitted as an undoubted truth: It was about the beginning of King *Charles* the I. that Mr. *Gellibrand* caused the great concave dial to be erected in the privy-garden at *Whitehall*, to fix a true meridian line, and with a large magnetic needle, shewing its variation from that meridian from time to time; and the Dr. thinks it would not be amiss, if exact observations were now made, whether the meridian be just the same, as it was then; for it is very possible, that the pole of the earth may in time suffer some little variation, which may not readily be discerned, that may cause an alteration of the meridian line; and this, if it is so, will be more discernible nearer the pole, than farther off.

What we call the dipping-needle, is admitted also to be an *English* discovery, to wit of Mr. *Blagrove*, which is somewhat older than the former; that is, that the magnetic needle, besides its horizontal direction towards the north, has also a direction of altitude above the horizon, if ballanced on an horizontal axis, pointing, as it were, with its northern extremity in our climate to some point within the body of the earth; whether or not this direction varies from time to time, as does that of its horizontal position northwards, the Dr. cannot tell, nor does he know, whether or not it has been observed, nor whether the southern extremity in other parts of the world dips, as the northern one does with us.

It is also an *English* observation, that not only a magnetic needle, but any piece of iron, if kept long in the same position, shall of itself contract a polarity; as for instance, an erect bar in a window, after long continuance in that position, will, if duly poised, be found with its upper end pointing towards the north, and with the other towards the south; and if afterwards, it be continued long in a contrary position, it will attain a contrary polarity; and Mr. *Gilbert's* notion (of the earth's whole body being but one great magnet, and lesser magnets so many *Terelle* or little earths, sympathising with the whole) is *English* also: It hath been likewise observed, that a magnetic needle, if heated red hot, will lose its polarity; and if then cooled in a contrary position, it will acquire a contrary polarity: It has further been observed by our *English* mariners, and that more than once, that upon a great flash

flash of lightning at sea, their magnetic needle has lost its former polarity, and acquired the contrary; in general, the doctrine of magnetism has been more improved by our *English* naturalists, than by any other nation.

The Way of taking and taming Elephants in the Island of Ceylan; by Dr. Strachan. Phil. Trans. N^o 277. p. 1051.

ALL the natives within 20 miles of the sea-coast, betwixt *Matura* and *Negumbo*, are subject to the *Dutch*; and therefore, when they have orders from the *East-India* company to hunt the elephants, they pitch upon a convenient place for a warren or park, which is broad at the entrance, and the farther you go, the narrower; so that at the extremity it is so narrow, that an elephant cannot turn itself; yet, this narrow place is so long, that 20 elephants may stand one behind another; the park being finished, the *Koolrale*, who is the head or chief of the *Kool*, or county, orders the inhabitants, who dwell thereabouts to their places; who surround the woods, where they know elephants are, for about 60 *English* miles in circumference; at first, each man stands from the other at the distance of 5 poles, or 25 yards, and kindles a fire in the intermediate spaces; and then by shouting, beating of drums, and sounding of horns, the elephants retire towards the park; and so the natives follow them by degrees, shouting, and making a noise, till the circumference become so small, that they stand close by each other; the elephants, when they find themselves inclosed within the park, make the more resistance, and some of them turn upon the natives; but posts are ready standing betwixt them and the elephants, and there are long stakes lying upon the ground; so that they need only lift these up, and fasten them at both ends to the posts, and thus the elephants are inclosed; then by following the elephants, and throwing of fire-brands, they chase them still farther towards the end of the park, and close up the passage behind them, by setting up, and laying stakes a-cross the posts, till at last the elephants are all entered into the narrow place, where they cannot turn themselves; there are several sorts of elephants, some a great deal higher before than behind, and several never have the two long teeth; others are of a more savage nature, known by their fierce looks, which are of no service, tho' kept for 10 years; such as these the King of *Candie* has for punishing transgressors, for they kill all that come within their reach; such like elephants being among the others in the aforementioned park, are kept out of the narrow entrance, by throw-
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ing fire-brands at them, when they draw near it; and the natives endeavour to kill them with shooting, and cutting off their trunks, by which they take all their food; and thus, when they escape, they perish with hunger; for the natives being very swift, come very near them with their swords; when all the choice of the elephants enter the narrow passage, there are posts put a-cross, so that none of them can come back; and such as are not fit for service, have liberty to escape.

It is easy to conceive, how the natives invented the method of hunting elephants with drums and shouting, because it is observed they themselves are affrighted by drums: Dr. *Sirachan* was told by an old *Portuguese*, that when his countrymen were in possession of this island, and pursuing the natives too far up in the woods, and hills, the *Ceylinese* by this means killed every man of them, excepting one drummer, who observing, that they did not draw near where they heard the drum, he kept continually beating on his drum; and the *Ceylinese*, imagining that the greatest power was where the drum beat, did not come near him, and so he saved his life: When the elephants have been some time settled in the narrow passage, they are taken one by one to the stable, being tied fast between two tame elephants bred for that purpose, the point of whose long teeth are cut; if the wild elephant is unruly, they hold his trunk with their trunks, and beat him with their teeth; and a man sits upon each of the tame elephants and directs them with a staff, upon the end of which is a hook, wherewith he touches his head, and orders the elephant as he pleases, without either bridle, or any such thing; when they come to the stable, they are laid between two posts, with stakes a-thwart before their breasts, and under their bellies, and bound in such a manner, that they cannot stir, nor lie down upon the ground; for should they be permitted to lie down, they would become heavy, sorrowful, and would not eat, but die; thus, they are fed with the trunk of *Wahugas*, or *Plantains*; the trunk of which tree they love better than any other food, and therewith they are also fed in the ship; when they have been so fed for six weeks, they begin to be tractable, and are fastened only by one foot with cords; and if the merchants come from *Bengal*, they are sold and conveyed to the ships; but if they do not buy them, they are fed with the leaves of the *Cocoa* tree, till 12 weeks after they were taken; and then they are as tame as a dog, and eat grass with the oxen in the fields; when an elephant is put a-board, there is a contrivance made of 15 or 20 double sail-cloths, which is laid about his breast, belly, and sides,

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and tied together upon his back, to which ropes are fastened; then he is led into the water, betwixt elephants bred for that purpose; upon which a man sits to direct him, and another elephant, upon which a man also sits, goes behind the elephant that is to be shipped; and when this is unwilling to enter the water the other that is behind, putting his head to the hinder parts of the foremost, pushes him forwards; and when he is got deep enough in the water, he is tied to the boat, the other elephants return, and he swims after the boat to the ship, where he is haled on board; but there is a more convenient method, which is this; they prepare a large flat-bottom'd vessel, covered with planks like a floor, so that this floor is almost level with the quay, then the sides of the quay, and vessel are adorned with green branches, so that the elephant sees no water, till he is aboard; when an elephant swims to the ship, or crosses a deep river, there is nothing seen of him but his trunk, thro' which he breathes; and when he is washed upon a river-side, he ordinarily lies with his head beneath the water level with his body; and tho' one side be above water, his head will be under, holding only his spout above it, thro' which he breathes: When the elephants are tame, they are very docile and tractable, so that they will lie down on their belly, when men are to get up and ride upon them; if they fall at any time, tho' on plain ground, they either die immediately, or languish till they die, their bodies being so bulky, causes the harm they receive by a fall; If an elephant frequents a plantation of fruit-trees belonging to the natives, for no hedges can keep him out, they point a heavy piece of wood, and hang it by a cord on the branch of the tree, under which the elephant uses to come; and at night a man sits watching upon that branch, and as soon as the elephant comes, the man cuts the cord, and so the pointed wood falls a foot deep into his back, by which means the elephant languishes, and dies.

An Account of a strange Cancer; by Mr. Kay. Phil. Trans. N^o 277, p. 1069.

MR. Kay's father had a cancer, which took its rise from a small bruise on the *Os Jugale*, and in process of time spread itself over all the cheek; and notwithstanding the endeavours of the most eminent surgeons in those parts where he lived, it ulcerated his eye quite round, which Mr. Kay saw him take out with his own hands; and afterwards extended itself to his ear, and thro' his cheek into his mouth, and across the upper part of his nose, and perforated the bone there; it likewise

over

over ran that side of his fore-head, fouling the *Os Frontis*, which came away in pieces, leaving the *Dura Mater* bare, for the breadth of a half crown, which rising thro' the perforation of the *Cranium*, in a few days putrified, and exposed the brain itself to view, several portions whereof came away fresh, and untainted; and what was most extraordinary was, that he perfectly retained his senses, and rose every day to dress the ulcer himself, till a considerable quantity of the brain was come away; and when he was confined to his bed, his speech failed first, and about four days afterwards, he died; his brain being totally consumed, and nothing remaining in the *Cranium*, but a small quantity of black putrid matter; he had neither *Spasmus*, nor convulsions of any part, all the time of his illness.

Natural Curiosities; by Mr. Ralph Thoresby. Phil. Trans. N° 277. p. 1070.

MR. *Thoresby* had in his *Museum* the outer skin of the maw of a fish taken at *Macassar*, which was given him by Mr. *Midgley*, who had it from a *Dutchman* at *Batavia*, who took it out of the fish; the fibres, or vessels do curiously and naturally resemble a tree, with its stem, branches, leaves, &c. the skin is very thin, whitish and transparent; and the veins that compose the stem, and the larger branches, are now rather black than dark red; the leaves are of a sort of dark and faded green, variegated: Mr. *Thoresby* had a flint, brought from *Milan*, which had somewhat within it resembling spar, that seemed to differ from the rest of its substance; tho' after all, spar, being nothing else but a crystalline sort of lime-stone, does not differ from a flint in reality, but only in appearance, that is, in the manner of its concretion; and if the inclosed substance had differed in its nature from the rest of the stone, the thing had not been very uncommon; for stones, especially those of a globular or oval form, have usually coat upon coat; and these coats are sometimes very different from each other, some being soft, and others hard; nay, sometimes, after a long time, one of these coats will shrink from the other, after the manner of a kernel, when the shell becomes dry; and then, if the inclosed substance continues soft, and marly, they call that stone *Geodes*; but if stony, it makes one of those rattling stones, that are known by the name of the *Ætites*, or eagle-stone; many instances might be brought, to confirm, that it is no unusual thing for stones to inclose substances of a very different nature from themselves; as appears by the shells in *Sussex* marble; and the stones found in the *Yorkshire*

shire coal-pits, known among the colliers by the name of cat-heads; they are found in a particular *Stratum* near the coal, and inclose a fern, or sometimes a polipody-leaf in the middle; and for that reason, being struck with a hammer, they break very readily there; they seem to be a sort of iron-stone, a-kin to what they call in *Staffordshire* *Ballmine*; and Dr. *Lister*, *Minera ferri pile-formis*; they have it upon the western coasts near *White-haven*, and call it there by the name of *Cat-scamps*; and Mr. *Thoresby* has seen of it likewise upon the *Yorkshire* coast in *Robin Hood's Bay*; and calls it *Lapis minere ferri, pile-formi similis in cujus meditullio, unum vel plura filicis folia representantur*, he had specimens of both sorts; and that one and the same piece of rock does not always shoot into a stone at one and the same time, but at first one part, and then another, and that not after the same regular manner; he had a piece of rock-crystal, wherein might be plainly observed, that the *modus concrefcendi* in the middle differed from that of the outside; nay, sometimes, he saw in the middle of some transparent stones, a little drop that never would take the solid form of the rest of the stone at all: Mr. *Thoresby* had also a piece of an iron-bolt, two inches long, found in a stone-quarry, and turned into iron-ore again; this being a property which iron has and no other metal, as Dr. *Lister* observed in his journey to *Paris*; he had likewise from *Sweden* a piece of copper-ore regularly shot into an octohedron; it had eight solid triangles, and consequently six angular points; it was found in the copper-grooves at *Fahlum*, where several of the same figure were found at the same time.

Subterraneous Trees in Hatfield-chace; and a remarkable Hydrophobia; by Mr. de la Pryme. Phil. Transf. N^o 277. p. 1073.

MR. de la Pryme, being at *Hatfield* in 1702, was told by several gentlemen, that about 20 years before, died one *Saunderson* of that town, aged near 80; whose father, much of the same age, had frequently assured him and others, that he could very well remember several hundreds of large tall fir-trees that grew in these levels, standing here and there, in a languishing condition, whose tops were all dead, yet their boughs and branches were always green, and flourishing; and *John Hatfield Esq*; who was not above 40 years of age, had by him a large twig, which his father had plucked off from a green and flourishing sprout of firr that grew from the great root of one of the same kind in these commons; and an old man of *Croul* heard his

his father say, that he could remember great numbers of shrubs and small fir-trees growing there before the drainage, and while this place was a chace, and the vert preserved; and lastly, by several old charters Mr. *de la Pryme* had seen of *Roger de Mowbray*, Lord of *Axholm*, who liv'd in the year 1100, relating to *Hurst*, *Bellwood*, *Ross*, *Santost*, &c. it appears, that all these places were then covered with a large old decay'd forest or wood; as also, all that low common between *Croucausway* and *Anthrop* upon *Trent*; and tho' there is not the least vestiges of any such thing now to be seen, yet it is not only plainly manifest, that it was a forest formerly, from the roots found there; but also, from the said roots it appears, that most of the trees which grew there were firs; all which were but the after-growth, and relicts of the large forest destroyed by the *Romans*.

Mr. *de la Pryme*'s brother had a grey-hound bitch that had whelps; soon after, a mad dog bit this bitch, upon which three weeks after, running mad, they were obliged to kill her; but, saving her whelps, because no signs of madness appeared in them, in about three weeks more they pull'd out each others throats, excepting one which escap'd; at length perceiving that it could not lap, nor swallow any thing liquid, some of the servants put their fingers into its mouth, and felt its tongue and throat, but discovering nothing amiss therein, they let it alone a day or two longer, and then it ran mad, and died; about three weeks after, one of the servants who was a very strong labouring man, and had frequently put his fingers into the whelp's mouth, began to be troubled with an exceeding acute pain in the head, sometimes once, and at other times twice a day, so very vehement that he was obliged to hold his head with both his hands, to keep it from rending asunder; which fits commonly lasted about an hour at a time; when his throat would contract, as he said, his pulse be tremulous, and his eyes saw every thing he look'd on of a fiery red colour; thus he was affected for a whole week together; but, being of a strong constitution, and returning to his labour, at every interval he wrought it off by sweat, without any physic; but it went worse with one of his fellow-servants, about 14 years of age, who was not of such a strong constitution; he was also sicke with a pain in his head, was, somewhat feverish, sometimes better, and sometimes worse, he cough'd much, had a good appetite, eat heartily, but could drink nothing; *I know not what I ail, says he; but I cannot drink*

drink any Beer, &c. and so laugh'd at it; when he went out of doors, if there was but the least north-wind, yet, he always ran, as if it had been for his life; and when he was ask'd, why he did so, he told them, *he could not tell, but that the Wind would stop his Breath*; a day or two after this, he was worse, and vomited an ugly sort of matter, like black blood, which stunk like rank-oil but much stronger, and this he did several times; after which, he would be pretty well, and walk about, but most commonly he ran as fast as ever he could, first out of one corner, then into another, then up stairs, and down again; but upon the third day of his confinement within doors, he became perfectly mad, would start, leap, and twist his hands, and arms together, point at people, laugh, and talk any thing that came uppermost; in some of his fits he was so strong, that four young men could hardly hold him down in the chair where he sat; but as soon as they were over, he was hearty, laugh'd and talk'd; but all his discourse was about fighting, and how, that if they would but let him alone, he would leap upon them, bite, and tear them to pieces; about an hour after, his fit return'd, which soon made him speechless, and affected entirely his brain, and then he died.

Spouts in the Mediterranean; by Dr. Stuart. Phil. Trans. N^o 277. p. 1077.

THE Dr. being on the 27th of *August* 1701 upon the coast of *Barbary*, to the northward of the town of *Bona*; upwards of 10 leagues distance at sea, about 7 a clock at night, soon after sun-set; there appeared in the N. E. which was directly up the gulf of *Lyons*, great and continued flashes of lightning one after another, hardly without any intermission; and thus it continued till next morning, without thunder, the flashes of lightning sometimes resembled the sudden appearance of a star, and at other times of a flaming sword, and again of a silver cord, stretch'd along the clouds, or like the irregular cracks of a phial from top to bottom; about eight next morning they had thunder, with a continuation of lightning such as was above-mention'd, all from the N. E. or thereabouts, about nine the same morning, there fell down from the clouds, which look'd dismally black, louring, and as it were, heavy with rain, in the said N. E. quarter, three water-spouts; that in the middle, seem'd to be as big, as the mast of a ship, and the Dr. judg'd it to be distant at least a league, and

and a half; the other two were not half so big; all of them were black, like the cloud from which they fell, and smooth without any irregularity; only that at first falling, some fell perpendicularly, others obliquely, and all of them were smaller at the lower than at the upper end, representing a sword; sometimes also, one of them would bend, and become streight again, and sometimes become narrower, and again increase its bulk; sometimes it would disappear, and immediately fall down again; at other times it would be extenuated to the smallness of a rope, and again become large as before: There was always a great boiling up of the sea, as in a *Fette d'eau*, or water-work; and this rising of the water had the appearance of a chimney smoaking in a calm day; some yards above the surface of the sea, the water stood like a pillar, and then spreading itself, it was dissipated like smoke; and the sword-like spout from the clouds, either came down to the very middle of this pillar, as if it had been join'd to it, as the largest pillar, which fell perpendicularly down, always did from the beginning to the end; or else it pointed to this column of water, at some distance, either in a perpendicular, or oblique line, as did the other two lesser ones: There were three or four spouts more, which appeared at the same time in the same quarter of the heavens, but not like the three former, either in bulk or duration; those last appear'd and disappear'd several times, during the continuance of these three aforesaid; it was hardly distinguishable, whether the sword-like spout first fell down from the cloud, or whether the pillar of water first rose from the sea; both appearing opposite to each other all of a sudden; only the Dr. observ'd of one of them, that the water boil'd up from the sea to a great height, without the least appearance of a spout pointing thereto, either perpendicularly, or obliquely; and here the water of the sea never came together in the form of a pillar, but rose up in a spreading manner, the sea boiling round the place; the wind being then N. E. the said boiling advanc'd towards the S. W. as a sitting or moving bush upon the surface of the sea, and at last it ceased; this shews that the boiling, or flying up of the water of the sea may begin before the spout from the cloud appears; and indeed, if there is any small matter of priority betwixt these two appearances, the boiling, or throwing up of the sea has it; which first begins to boil, and then forms itself into a pillar of water, especially on the lower part thereof: It was observable of all of them, but chiefly of the large pillar, that towards
the

the extremity it began to appear like a hollow canal, only black in the borders, but white in the middle; and tho' at first it was altogether black and opaque, yet one could distinctly perceive the sea-water fly up along the middle of this canal, as smoke does up a chimney, and that with very great swiftness, and a very perceptable motion; and then soon after the spout, or canal burst in the middle, and disappear'd by little and little; the boiling up and the pillar like form of the sea-water continuing always the last, even for some considerable time after the spout disappear'd, and perhaps, till the spout appear'd again, which it commonly did in the same place, as before, bursting, and forming itself again several times in a quarter, or half an hour.

The Dr. supposes that this phenomenon may be solv'd by suction, or rather pulsion, as in the application of a cupping-glass to the flesh, after the air is first exhausted by the kindled flax: It was further observable, that the oblique spouts always pointed from the wind; that is, when the wind was at N. E. the oblique spouts always pointed to the S. W; tho' at the same time there were others perpendicular, which still continued so, notwithstanding the wind; as also, that such as were curv'd, had still the convex side from the wind, and the concave side towards it; that is, the wind being at N. E. the concave was towards the N. E. and the convex towards the S. W. It rain'd a great deal during the continuance of these spouts, and after their total disappearing, there was half an hour's violent storm from the N. E. with very little rain; and after that the weather clear'd up.

Plate III. Fig. 2. A the spout of a black colour, falling perpendicularly from a black cloud; B the water of the sea, rising in the form of a pillar or column in the middle, and scatter'd round the said pillar, like smoke, or rather like the falling of a *Jette d'eau*; these two met each other directly, and the column of water from the sea is commonly grosser than the spout from the clouds.

Fig. 3. A a curved spout, joining with the rising water of the sea at B.

Fig. 4. A represents a black spout, falling obliquely from the clouds of the same colour; B the ascending column of the sea-water as in Fig. 2: with this difference, that both the spout and column of water did not meet.

Fig. 5. E and W represent east and west; 1, 2, 3, the successive progress of the boiling of the sea from east to west, or
from

from N. E. to S. W, and that without any appearance of a spout from the clouds, pointing to either of these places.

Fig. 6. A represents the large perpendicular spout, a little before its bursting, white in the middle; B the column of sea-water joining therewith, 2, 2, 2, 2, the water of the sea, ascending in the form of smoke up a chimney, all along the column at B up to the clouds.

Fig. 7. A, the bursting of a perpendicular spout, commonly beginning in the middle at *a*; B the rising of the sea-water, begins to cease, and the middle column to disappear.

Fig. 8. A, an oblique spout, which after reaching the sea in a curved line, or obtuse angle, does soon after burst at *a* and disappears; B the rising of the sea-water also beginning to cease.

Fig. 9. A, a perpendicular spout beginning to fall; B the water of the sea under it beginning to ascend.

Fig. 10. A, an oblique spout beginning, or darting itself out of the clouds; B the rising, or boiling of the water, answering to it in an oblique line; these sometimes reach down to the sea, or rising water, and sometimes they do not reach thither, but continue a while, as here represented.

The Way of catching Fowl and Deer in Ceylan, &c. by Mr. Strachan. Phil. Trans. N° 278. p. 1094.

THE method they use in catching water-fowl is this; in loughs and waters, which are not very deep, the fowler puts an earthen pot upon his head, in which pot there are holes bored, thro' which he may see; then he wades into the water, nothing being seen but the pot, and thus he enters into the midst of all the fowl, they, taking it to be a floating block, or some such thing, take no notice of it, tho' it be close by them; then the fowler takes hold of one by the leg, and pulling him under water, wrings his neck about; the rest of the fowls, not perceiving this, sit still; then he goes to the next, and does the same, and so on, till he catches as many as he pleases; such as have guns, make a frame, which they cover with green branches, so broad as to cover their whole bodies, they stand behind it, then the fowler carrying the frame before him, the fowl or deer seeing nothing but the green branches, is not affrighted; and thus advancing near enough, he fires; it is surprising how some beasts are affrighted with fire, as lions, tigers, wild swine, &c. and as the *Ceylanese* chase the elephants, wild swine, and tygers from their plantations by fire, and the natives at the *Cape of*

Good Hope chase the Lyons from their cattle; so the *Ceylanese* catch harts, deers, elks, and hares, which they perform thus; two men go in the night-time into the wood; one of these takes an earthen vessel upon his head, wherein is a fire burning, made of sticks, and a kind of rosin; and in one hand he carries a staff, on which are fastened eight bells, the more harmonious they are so much the better; the other man goes behind with a spear in his hand; whenever the deer perceives the light, and hears the bells, he draws near, standing amazed, for he does not see the men; in the mean time, the man with the spear penetrates thro' his body, and catches him.

There are two sorts of serpents, which are thought not to be venomous, and which a *Ceylanese* will not kill; the first, is of a blueish colour, and frequently comes into their houses in quest of rats only, which he eats; he creeps into their nests, and destroys them all; this serpent is an inch and a half thick in diameter, and about two yards and a half long; the other is green like the leaf of a tree, on which it winds itself, climbs up the trees, and catches birds; lying still, as if it had no motion, till it sees a fit opportunity to catch its prey; this is about half an inch in diameter, and a yard long: The *Talgoi*, or ant-bear, will lie down, as if he was dead, by the little nests which are built by these ants called *Waia*, lolling his tongue out as far as he can; the ants will immediately fix themselves in great numbers upon its tongue, then drawing his tongue in, he swallows them; and then he shoots forth his tongue again, continuing so to do, till he has satisfied his hunger: There are two sorts of cinnamon-trees, of which the best has a leaf much larger and thicker than the other; but no other perceivable difference; if the leaves of both sorts are distilled, they yield oil and phlegm, as if cloves had been put into the still; upon the root of the tree there is a thick bark, which, when distilled, as the former, yields both oil and camphire, which are separated, by covering the receiver with a linen cloth, and the camphire will remain in a lump together in the cloth, and the oil and phlegm will run into the receiver; this camphire has the same colour, the same dissolving, dissolving, healing, and balsamic quality with the camphire of *Japan*; the oil has the like virtue; for anointing scabs, itch, and excoriations therewith, it cures them in a short time; drinking the phlegm mixed with common water cures fluxes, and does service to such as are under that languishing disorder, called by the *Dutch* the *Land's Disease*, and by the *Ceylanese*, *Pipa*: Mr. *Sratchan* never saw the natives use cinnamon, tho' they scarcely

scarcely have a meal without pepper; nor is it used by the *Europeans* either in meat, or distill'd among arrack, or infused in their drink; for, it is thought to occasion shortness of breath; whether this be the cause of it, or whether the *Ceylinese* are afraid to bring it to particular persons, seeing the *Dutch* have severe laws against selling it, he cannot tell.

Parhelia and Circular Arches in the Air; by Mr. Halley.
Phil. Trans. N° 278. p. 1127.

ON the 8th of *April* 1702, about 10 o'clock in the morning, the air being clear, Mr. *Halley* observed, whilst the sun shone but faintly, or appeared waterish, several arches of circles round him, as is represented Plate III. Fig. 11. whereof S is the true sun; Z the *Zenith*; STPP a large white circle passing thro' the sun, parallel to the horizon; it was very distinct and entire, about two degrees broad in the northern part about T; it had much the same breadth in the east and west, but grew narrower towards the sun; its edges were not very well defined, the whole appearing like a faint white cloud, and a part thereof would have been taken for such; but the whole circle seen in the pure azure sky was very extraordinary; VNXY a halo, or rather iris, that was also an entire circle, having the sun for its centre; Mr. *Halley* computed its semi-diameter to be much about 22 degrees; the breadth of this arch, which was well defined, was by estimation equal to the sun's diameter, and it was coloured with the colours of the iris, but nothing near so vivid, as in the common rainbow; the red colours were next the sun, and the blue in the outer limb; within this circle the sky appeared somewhat obscure, especially near the arch; and Mr. *Halley* supposed that the cause of that obscurity, was likewise, that which made the sun shine so faint and waterish; PUP is an arch of another circle, of which only the upper part appeared, it was in all respects, both for breadth and colours like the circle VNXY, which it touched in the vertical point V, but its centre was below at N, or near it; in the interfections of this arch with the white circle on both sides, there were two very bright *Parhelia*, which were also tinged with colours, especially on the side next the sun, where they were very red; having measured their distance from the true sun, he found it 31 degrees and a half; about V, where the two arches were co-incident, it was also very bright, and the red on the inside was very strong; but the species of the sun was there so drawn out in length, that it could not properly be called a *Parhelion*;

this arch PVP broke off on both sides, about five or six degrees below the *Parbelia* PP. At N, or the lower part of the circle UNXY, there also appear'd a small piece of an arch, which touch'd it in the same manner as PUP did in V; it seem'd to have its centre in V; and about N there appear'd another longish red species, such as at V, but not altogether so bright.

The height of the sun, during the observation, was from 40 to 45 degrees, when by the interposition of clouds, there was no more to be seen; the weather was cooler than ordinary, with a gentle north-west wind; and it was plain, that the vapour which caused this appearance, was higher than the clouds, for they were seen to drive under the circles.

Roman Inscriptions and other Antiquities in Yorkshire; by Mr. Hunter. Phil. Trans. N° 278. p. 1129.

THERE was a Roman station in the county of *Durham*, at a village called *Ebchester*; it was surrounded with a wall of hewn stone, and seems to have been an exact square of about 200 yards on every side; there have been suburbs here towards the west, south, and perhaps east, of a considerable extent; but towards the north the wall stood upon the top of a steep bank, under which runs the river *Derwent*, in which was found a long altar, but its inscription was defaced; as also a lesser stone, with this word H A V E on one side; there is another, which is used as a grave-stone, that lies before the church-door, which seems to have been Roman, by the engraving of a man from the breast upwards in a Roman dress; in the ruins of this place, several inscriptions have been dug up by the inhabitants, and in most places, they could plainly discern two different foundations of ruin'd houses; and most of the stones thus dug up were tinged with a deep red colour, undoubtedly, by fire; that part of the village, which stands within the walls, is called the *Mains*, where are most of the ruins; there are also several tiles of a red clay dug up, but not one of them entire: Upon undermining an old foundation still visible on a hill-side, there was found a considerable quantity of pewter: *Watling-street* passes by this place about 100 yards to the west, which could not conveniently be brought thro' the town, by reason of a brook 2 or 300 yards to the south, whose banks are very uneven; and the above-mention'd steep hill, towards the north, makes a passage that way next to impossible; Mr. Hunter could meet with no certainty, whether the Romans ever laid a bridge over *Derwent* at *Ebchester*, but he thinks it probable they had, both from the number

ber of soldiers, which must needs pass that way, as also from the considerable largeness of this river.

From the following passage in the second book of *Ptolemy's Geography*, *sub Elgovis & Olludinis ad utraque maria habitant Brigantes, in quibus Urbes Epiacum, Vinnoyium, Caturadontum, Calatum, Isurium, Rhigodunum, Olcana, Eboracum, &c.* Mr. Hunter supposes, that this might probably have been the *Epiacum* of the Romans, especially, if it be granted, that this author mentions only the places in the eastern parts of this province; but, if *Epiacum* be placed at *Papcastle*, and *Rhigodunum* at *Ribchester*, then it will thwart this assertion; and indeed, Mr. Hunter is apt to think that *Ptolemy* begins his enumeration of the places amongst the *Brigantes*, at the place nearest *Adrian's wall*; and has advanced in order, tho' with some omissions to *York*, the chief town in the province; and further, the modern name *Ebchester* agrees with *Epiacum*, as well as *Papcastle* does; for, the mutation of P into B is usual.

Most of the words in the *Roman* inscriptions Mr. Hunter saw, were so artificially erased, that he is apt to think, they were thus defaced upon some revolution in the *Roman* government; these stones, with several more, beautified with inscriptions and sculpture, were dug up in a field called the *Bower*, about half way between the *Roman* wall and south *Tine*, and near two miles west from *Busie-gap*; and here was kept a *Roman* garrison; it was surrounded with a single wall, and was square, but now it is nothing but heaps of stones, overgrown with bushes; on the west-side of this place, about 50 yards from the walls thereof, there was discovered under a heap of rubbish, a square room strongly arched a-top, and paved with large square stones set in lime; and under this a lower room, whose roof was supported by rows of square pillars, about half a yard high; the upper room had two niches, like, and perhaps, in the nature of chimneys on each side of every corner, or square, which in all made 16; the pavement of this room, as also its roof, were tinged black with smoke; the stones used in arching the upper room were marked, as joiners do deal-boards for chambers; those Mr. Hunter saw, were number'd x. xi. xiii. there was found, in this ground, a winged image, that was about three inches long, but wanted the head and feet; the other inscriptions were all found near the *Houseteads*, a place so call'd from the abundance of ruins there, about half a mile from *Busie-gap* towards the west, and just within the *Roman* wall; among the ruins were found several pedestals, two or three pillars, and two images, but somewhat defaced.

Mr.

Mr. Hunter found *Watling-street* very visible from near *Ebchester*, almost to *Corbridge*, which is about seven miles; Mr. Hunter travelled upon this street almost to *Resingham*; and it is very visible all the way; about a mile south from *Resingham*, there is a pillar about eight foot long, which stood by the way-side, but is now fallen; a brass-medal was found here, the Emperor's name was worn off, only *AUG. PIUS* was very legible; and by the figures of other medals, he took it to be one of *Antoninus's*, on the reverse was a wolf, without any inscription; the next Roman town he visited, was *Rochester*; some part of the way *Watling-street* was very visible; tho' this was not the largest, yet Mr. Hunter supposes, it has been one of the best fortified places the Romans have been masters of in the north; and indeed, it was necessary it should be so, since it was not only a frontier town, but was surrounded with enemies; from this place he returned to the Roman wall at *Carrow*, between which, and *Wakwick*, the wall has been repaired, and fronted with its old stones again.

The Planting and Culture of Tobacco in Ceylan; by Mr. Strachan. Phil. Trans. N° 279. p. 1134.

THERE are here two sorts of tobacco, both which are called *Dunkol*, i. e. a smoking leaf; the one is *Hingele Dunkol*, or *Singele Dunkol*, the other is *Dunkol Kapada*, which last is very intoxicating, and much stronger than the former; they are both of the same species, and the only difference is that *Singelese* tobacco requires but little culture, whilst a great deal of pains is taken upon the other, till it is fit for use; and it is done after the following manner; the natives clear a little piece of ground, in which they sow the seed of tobacco, as gardeners do parsley and coleworts; against the time that this is ready for transplanting, they chuse a piece of ground, which they hedge about; when the buffelo's begin to chew the cud, they are put into this hedged ground, where they continue day and night, till it is sufficiently dung'd; and then it is turned up with a spade, in form of a pick-ax, such as carpenters dubb planks withal, by houghing the ground, and mixing the manure with the soil; when the ground is made smooth, they remove the plants out of the bed wherein they were sown, and set them here, about a foot distant from each other, and then they grow up almost like a dock; when the stem has got 15 leaves, they cut off all the tops; and if they do not desire to have the tobacco very strong, they let it grow, till it has 18 or 20; but, when they would have

have it strong, they top it when it has got 10 or 12 leaves, not reckoning the three or four which are nearest the ground, because, they never grow so big, nor so good as those above them; thus, the moisture of the ground not being wasted in leaves, flowers, and seed, it makes the remaining leaves four or five times larger, fatter, fuller of strength and virtue, than the tobacco which is not order'd after this manner; now, the moisture ascending from the root, being confin'd within the compass of these leaves, forces its way between the stem, and remaining leaves, emits young shoots, and would grow forth in branches, if no care was taken to hinder it; therefore, every third or fourth day they go thro' all the stems, and break off their buds; and this they continue to do, till the leaves are ripe, (which takes up as much time as the *Singelese* tobacco, which has flowers and ripe seed, and then begins to wither and spoil, if no use is made of it) which is known by their firmness and thickness; then, whilst the leaf is green, before it begins to wither, the natives cut down the stem together with the leaves, and carrying them home, they lay them in a heap; and thus, the leaves will begin to ferment, turn hot, and sweat; and when they begin to sweat, they turn the inside out, that they may ferment easily, otherwise the innermost would ferment too much, spoil, and rot; thus, the longer they lie in a heap together, the tobacco turns darker colour'd; when they think it has sweated enough, they hang it asunder upon cords, till the leaves are dry; then they separate the leaves from the stalks, and lay them up in bundles till they have occasion for them.

The other tobacco called *Singele Dunkol* is only sown, and then transplanted, having liberty to grow, shoot out into flower, and seed, which ripen altogether; then it is cut down, and thrown together in a heap; some will ferment too much, and rot; others will not ferment at all, and continue green, tho' dry, and smell like hay or dry grass; some of the soldiers, that love to smoke a large pipe full, and often use this common sort, will mix some of the *Kapada* amongst it; the *Cingaleses*, who do not smoke so much at once, nor so frequently, take a piece of the *Kapada*, and roll it together, then roll a piece of dry leaf of the *Wattukan*-tree about it; they kindle it at one end, and suck at the other, till it is consumed; some again chew it amongst *Betle*, taking but very little at once.

*The Animalcula in Semine masculino of Cocks and Spiders;
Shortness of Breath, &c. by M. Leewenhoeck. Phil.
Transl. N^o 279. p. 1137.*

M. *Leewenhoeck* had often observ'd, that young cocks that were not arriv'd to half their growth, were wont to tease the young hens to couple with them, which the latter always refused till they had laid eggs, that is, till they were three or four months old; this made *M. Leewenhoeck* conclude, that when the young cocks were thus stimulated to copulation, the *Animalcula* in their seed were living, which upon viewing, he always found to be so; having opened the seminal vessels of a young cock that was newly killed, pluck'd, and still warm, he also discover'd these *Animalcula* living, and they continued alive for half an hour, after he had squeez'd a drop of the seed out of the said vessels; these *Animalcula* appear, both when they move, and when they lie still, as if the fore-part of their bodies was crooked, or circular. Plate IV. Fig. 1. A B C D represents one of those *Animalcula* in its full length, whereof A B C is the body, which seldom is quite streight, but the tail is for the most part folded; C D shews its tail, which is long, and exceeding small; in the fore-part of the bodies of several of those *Animalcula*, *M. Leewenhoeck* discovered a bright spot, which was not to be seen in others; and the tails of such as lay dead were like so many bows, as represented Fig. 2, 3, 4, 5; from hence, he supposed, that the *Animalcula* in *Semine masculino* of other animals are also provided with long tails; on the 17th of September, about 10 o'clock in the morning, he again viewed the Semen of a young cock, which was judged to be about 12 weeks old, and had been killed an hour before, wherein he found the *Animalcula* alive; he took some of the same seed, about the quantity of a pin's head, ordering it in such a manner, that very little of the fluid matter could exhale; he observed it every hour, and about 7 o'clock the same evening, he found the *Animalcula* as lively, as if they proceeded from a cock newly killed; but, about 8 or 9 o'clock, he could perceive several of them dead, and in one place, which was no larger than a grain of sand, there were great numbers of them still living; but a little further, and in a place of much the same extent, he could not perceive the least motion in such as lay there; the 18th of September, about 7 o'clock in the morning, and also about noon, *M. Leewenhoeck* again made his observation of the same Semen, as it lay in a glass-tube, as large as a thick pin, but he could discover no life
in

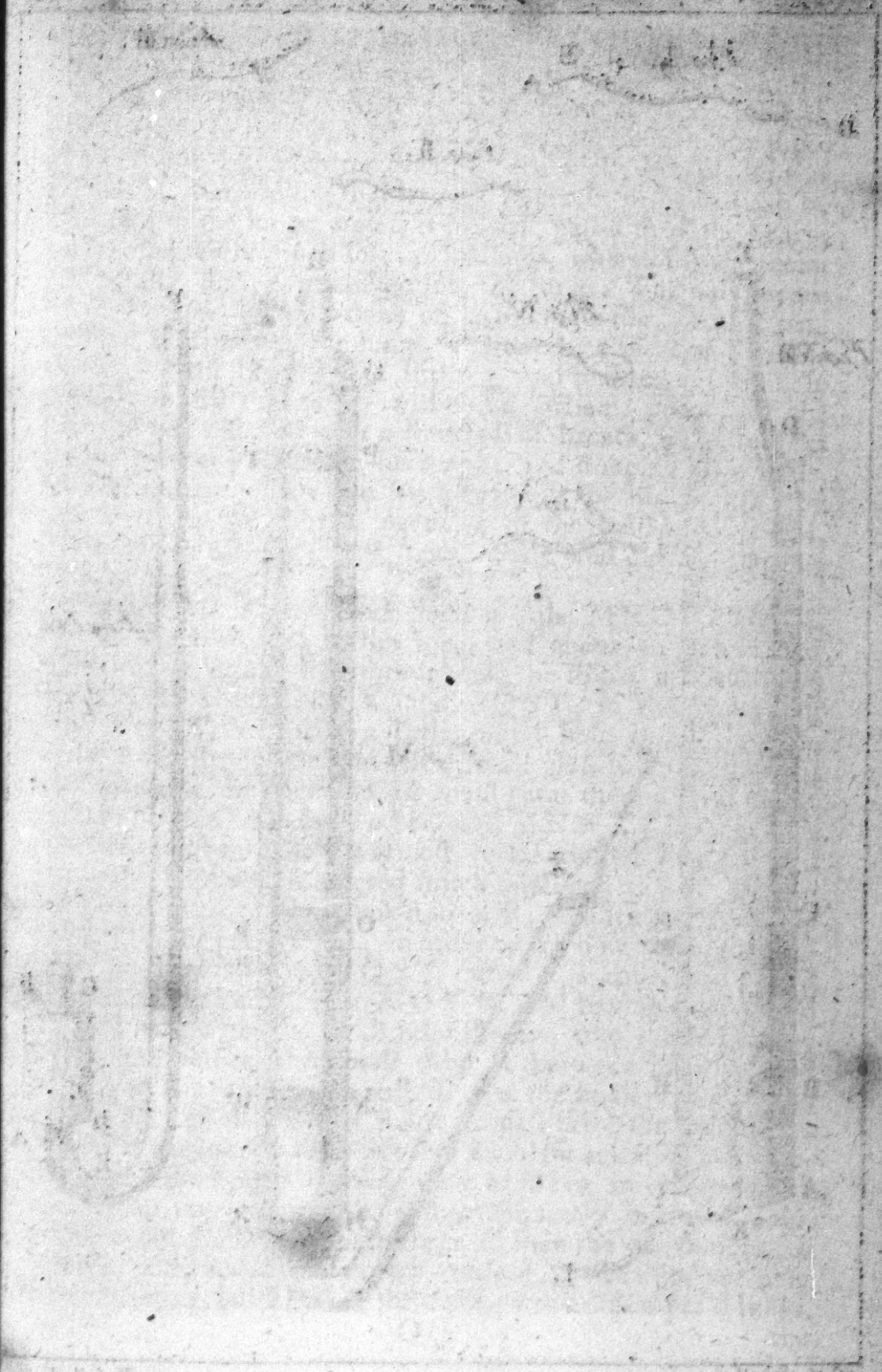
in the *Animalcula*; but, when he look'd upon another part of the same matter, of the bigness of a large grain of sand, and spread very thin upon the glass, he saw several very lively and nimble in their motions, but their life and motion dwindled away, till at last he could perceive none; the reason of which M. *Leewenhoeck* judged to be, that all the thin fluid matter was exhaled from the seed, and that then the *Animalcula* presently die; in order to be further satisfied in this matter, he took a dead cock, that had been kill'd and pluck'd the day before, between the hours of 7 and 9 in the morning, and opening the body, he pull'd out the guts and stomach, the better to come at the *Vasa Deferentia*; out of one of which he squeezed a drop of the seed, and putting it directly before his microscope, he could see a vast number of those *Animalcula*, swimming in legions together, and crossing each other like clouds in a stormy day, and as brisk and lively, as if the cock had been newly killed; M. *Leewenhoeck* put into the body again, that part of the intrails he had taken out, and drew the skin over it, in order to take out a little more of the seed about six hours after; and accordingly having taken out a little about noon, he found the *Animalcula* therein still living; but in the evening about six, having again taken some of the *Semen* out of the *Vasa Deferentia*, he could not perceive any of them living; then, he open'd those vessels in several places, even where they terminated in the testicles, but the *Animalcula* were all dead: Seeing that the *Animalcula* in *Semine masculino* are alive when taken out of the cock's body, and so long after the cock itself is dead; it is probable, they are designed to fasten in the hen's *Ovarium*, or egg-nest, and impregnate not only one, but the several yolks, which compose the bed of eggs; the rather because we find, that by one coition of the cock and hen, most of the eggs, the hen lays in a month or two after, are impregnated; M. *Leewenhoeck* has often thought, whether or not, each of the yolks in the *Ovarium*, which have not arrived to the hundredth part of their growth, are not designed to receive one of those *Animalcula* from the seed of the cock, and keep it there, till the yolk is surrounded with the white, and the necessary heat introduced; the rather because, we know that from the white the chick receives its first growth.

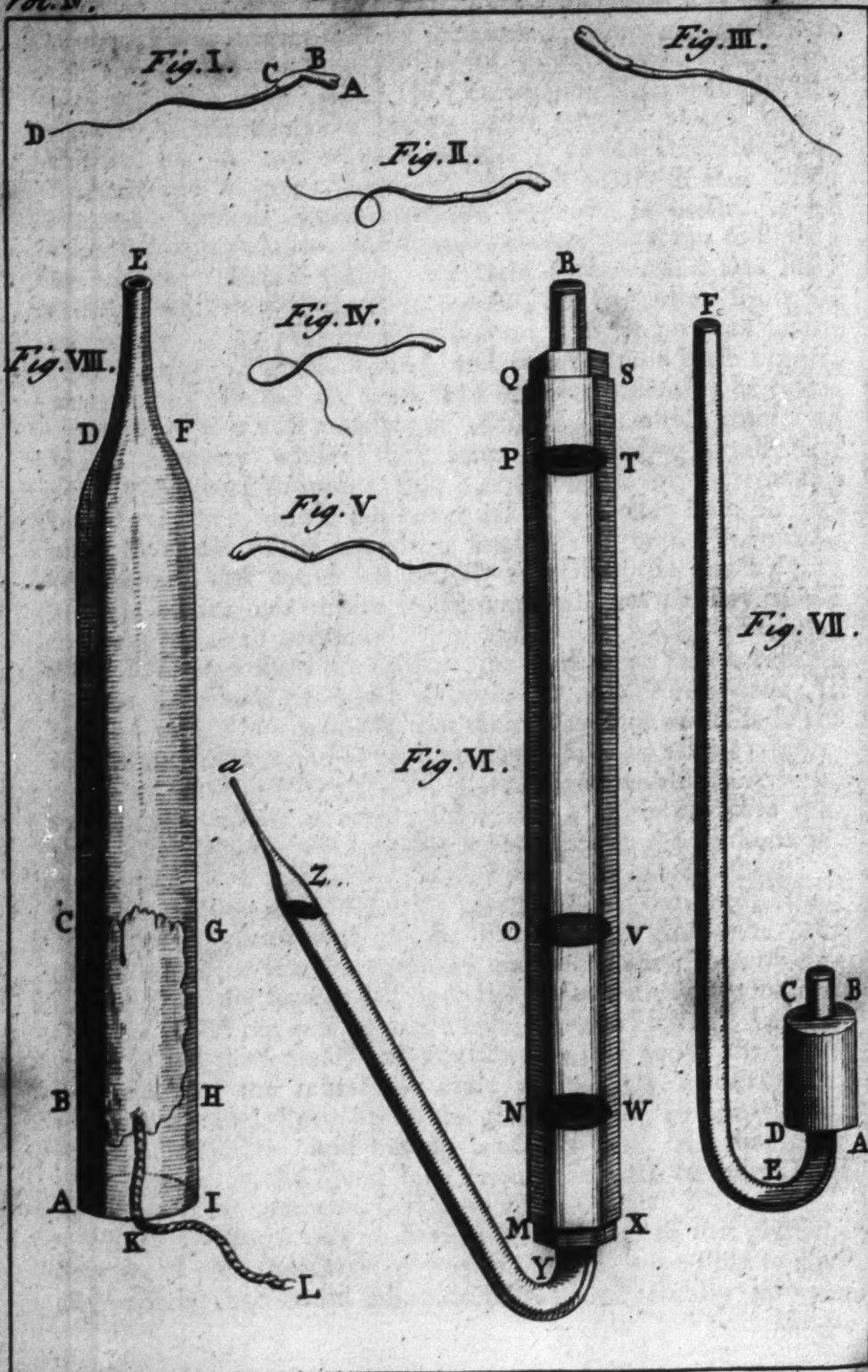
A certain gentleman, that had often consider'd the nature of spiders, and their copulation, told M. *Leewenhoeck* that he could seldom meet with the males of the large spiders, and that he believed the females killed and eat them up; and M. *Lee-*

wenhoeck was further told by the same gentleman, that where the females of the smaller sort of spiders were seen, there was also one male, which *M. Leewenhoeck* accordingly observed: *M. Leewenhoeck* having often been in places, where thistles, nettles, and other weeds grow, he saw several sorts of spiders, and in great numbers; and he observ'd, that when the male spiders approached the females, in order, as he thought, to copulation, the females always put them to flight; he took up, several times, the male spiders, and was fully satisfied that that little white matter, he had often squeez'd out of the hinder part of their bodies, and which was sometimes as big as a grain of sand, and sometimes a little bigger, was nothing else but the male seed of these animals; he discovered therein a vast number of *Animalcula*, which continued living a pretty while; they were so exceeding small, that *M. Leewenhoeck* supposes, that 1,000,000,000 of their bodies joined together, would not be equal to a barley-corn in bigness; by reason of the exceeding smallness of these *Animalcula*, *M. Leewenhoeck* could not possibly represent the exact figure of their bodies, nor of the instruments wherewith they mov'd so strongly, as to continue living above five hours, after they were separated from the spiders; he had 10 or 12 other male spiders, in which he could discover no new *Phænomena*; so that he took it for granted, that their *Membrum virile* is in the hinder part of the body, tho' he never saw an actual copulation; in these last spiders, *M. Leewenhoeck* could perceive no seed at all; which he attributed to one or other of these reasons; either the male seed was not yet ripe enough in them, or, it may be, they had lately coupled before he catch'd them; it sometimes happened, that by pressing out the seed, their *Fæces* were mixed with it; he shut up in a glass-tube three males and one female together; and after the space of two days, he saw the female fall upon the males with such violence, that the blood ran out of their feet; upon which *M. Leewenhoeck* killed the female, and next day he saw two of the males lie dead, and the remaining male was eagerly devouring the female; he had shut up in the glass-tube for 48 hours three other male spiders, and having hinder'd them all that time from copulation, he found seed enough in each of them; and he observ'd the *Animalcula* therein alive.

M. Leewenhoeck was persuaded of the truth of this position, that in cases of shortness of breath, it was impossible to find any vehicle that could insinuate balsams effectually into the lungs,

PLATE IV





lungs, and that it was in vain to anoint the breast and stomach therewith, as what could never reach the lungs; and that the scent of the balsam, which exhaled from such as used to anoint their breasts with oil, did not evaporate from the pipes of the lungs, but from the breast by the neck; because he was convinc'd, that nothing that is in the stomach, or bowels can be convey'd to the lungs, unless it has first pass'd thro' the heart; and consequently much less can balsams, wherewith we anoint our breasts, find any passage into the lungs: The only means M. *Leeuwenhoeck* could think of, to insinuate the invisible particles of balsam into the lungs, was to take a piece of silver or copper, of the bigness of a shilling, and making a little hole therein, to fill the cavity with some balsam, proper for the lungs of one affected with a shortness of breath, and after that let the patient put it upon his tongue, and stopping his nostrils, let him receive no air into his lungs, but by his mouth; by which means the subtil particles of the balsam, which M. *Leeuwenhoeck* calls its spirits, may exhale and descend into the pipes of the lungs.

Further M. *Leeuwenhoeck* took a tube MNOP Plate IV. Fig. 6, which was 15 inches long, and about an inch in diameter, of an equal size throughout; he stop'd it at each end with a cork, as at MNWX, and PQST; in the uppermost cork PQST, he made a little round hole quite through, wherein he strongly insinuated a small glass-tube R, that not only no water, but even no air could enter therein; and in like manner he perforated the other cork MNWX; having done this, he thrust into the lowermost cork, another long crooked glass-tube YZ, which tapered into a small end as Z*a*; on purpose, that the air, when suck'd in at R, might enter leisurely at the streight passage Z*a*; in order to try how it might succeed, he drew the cork PQST out of the tube, and pour'd a little brandy into it, as in NOVW, and having then plac'd the said cork with the small tube therein, into the large tube again, and putting the small tube R between his lips, and sucking in the air, which rush'd in at the small end *a* of the tube YZ, and which was made to pass thro' the brandy, he perceiv'd the brandy to be put into a violent agitation and bubbling, and the spirits thereof made to rise in an extraordinary manner up into the mouth, and consequently into the lungs, as the event plainly demonstrated: If then the exhalations, or volatile particles of balsam are rendred serviceable, not only for comforting, but likewise for curing weak distemper'd lungs,

the more of the spirits of these balsams can be conveyed into the lungs, so much the better it is for them; yet he would not have the air pass so simply thro' the balsam, as through the brandy, when the tube should be fill'd with the former to the same height as it was with the latter, but intended, so far as it was fill'd with balsam to put it into hot water; however, in order to prevent the bursting of the tube by too sudden a heat; it should be laid in a bason fit for the purpose; with some cold water, pouring softly a little boiling water thereon to the height of the balsam, or else to lay the tube in a bason with the necessary quantity of water, and put it upon the fire; by this means the spirits of the balsam will exhale much more freely, than when it is cold, and the lungs will be heated in such a manner thereby, as to put the patient into a gentle sweat: M. *Leeuwenhoeck* often thought, that these balsams, or at least some cordial gums, herbs, or juices, are not only good against shortness of breath, but do also preserve the lungs from cold stinking mists, and pestilential air; and the best balsam for shortness of breath is that of *Peru*: M. *Leeuwenhoeck* prepared such a tube, as is represented by Fig. 7. A B C D E F, which was longer than that by Y Z a in Fig. 6. for this reason, that if a person had a mind to put more balsams, or juices into the tube, this long pipe might be thrust up higher into the water.

Now if we consider the structure of our bodies, as far as they are known to us, we may firmly conclude that no part of us is expos'd to so many disorders, as the lungs; for, how easily may they be hurt, if we do but go into the cold air, which ingenders, and causes us to discharge phlegm, to cough and spit; and how easily are the globules of blood in the fine vessels of the lungs coagulated by the cold.

In order to get further light into these matters, M. *Leeuwenhoeck* view'd with a microscope the smallest parts of the lungs of two several sheep; and therein he discover'd that the air-vessels were fill'd with purulent matter, even at the extremity or smallest part of the lungs; a butcher coming to view the lungs, he felt them in several places, and shew'd M. *Leeuwenhoeck* some hard parts about the length and breadth of two fingers; and he told him that that sheep had catch'd cold, which had occasion'd that distemper in its lungs; and upon M. *Leeuwenhoeck*'s asking whether the sheep would not have died of that disorder, he was answer'd that those hard parts do often disappear: M. *Leeuwenhoeck* could not discover the least
puru-

purulent matter in the air-vessels of the lungs of two other sheep, which were of an agreeable colour, and like the others: Having view'd the outside of the lungs of a sheep that had no distemper, it seem'd to him that a great many small transparent globules lay under the membrane; but, upon separating the membrane from the liver, these transparent globules appear'd to be nothing else than little particles of air compressed together into various and irregular figures; and these globules seem'd to lie out of the air-vessels: M. *Leeuwenhoeck* took several pieces of the lungs, and pressing the blood out of the vessels in which it lay, he found that a vast number of bubbles of air proceeded from those vessels; some of which were so exceeding small, that they even escap'd his microscopes; those globules M. *Leeuwenhoeck* suppos'd to be contain'd in very fine vessels; and when the blood and air were squeez'd out of that part of the lungs, where there were no large vessels, the remaining ones, whose tunics were exceeding fine, did together compose but a very small portion of matter: Moreover, he took the unsound lungs of two other sheep, and in handling them, he found that their parts were much harder than others, that were not distemper'd; and that the purulent matter was tougher, or thicker in those lungs, than in the above-mentioned; and looking on the external parts of these lungs, he perceiv'd, in several places thereof, pellucid particles, which far exceeded in bigness the globules of air before spoken of; these clear particles were in some places of a greyish colour; but in others somewhat darker; M. *Leeuwenhoeck* having taken the last mention'd particles out of the lungs, they seem'd to be nothing but a hard substance, and the rather, because upon separating them, he could see no air-globules amongst them; whereas in sound lungs, how small soever the pieces thereof were, he could easily discover, that, excepting the veins, they consist'd mostly of air-globules, which were not shut up within the veins; now, if the said transparent particles were not in sound lungs, M. *Leeuwenhoeck* would conclude that all of them would turn to a thin matter, in order to be thrown off the lungs by the sheep, if it should recover its former health; if we look upon sound lungs, we would be apt to affirm that those also consist'd of such transparent particles; but upon a nearer view, M. *Leeuwenhoeck* found that that phaenomenon was only occasion'd by a multitude of blood-vessels lying within the membrane of the lungs, and in several places seeming to divide the globules of air: M. *Leeuwenhoeck*
being

being now persuaded, that all the distempers in the lungs of sheep are occasion'd by the cold air they suck in, he ask'd two butchers, whence they thought the diseases in their lungs proceeded? And they made answer, that the sheep running in the meadows at the latter end of autumn, and eating grass, that was either actually frozen, or cover'd with cold dews, was the true reason their lungs were thus spoil'd; and that this sometimes happen'd even in *May*; but M. *Leewenhoek* for his part, would rather conclude that the frozen grass does not hurt their lungs, but their stomachs; M. *Leewenhoek* knowing that the butchers fetch'd abundance of sheep from *Brabant*, and that they are driven every morning into the field, and folded every night; and on the contrary, that their own country sheep were brought into the meadows in *May*, and left there till it snows and freezes; M. *Leewenhoek* ask'd the butchers, whether the *Brabant* sheep had such bad lungs as the latter; and was told, seldom, or never; from whence he was still the better satisfied, that the distempers in the lungs of sheep, and especially of such as lie in the fields in long cold nights, were occasion'd by nothing else, but their sucking in the cold air: Moreover, M. *Leewenhoek* ask'd, whether such sheep were fat, whilst they were kept up, and whether they could distinguish which, while living, had bad lungs; to which they answer'd, that those whose lungs were touch'd, did never increase in fat, after they were folded; and that within a fortnight's time, after they were penned up, and fed with beans in order to fatening, the distemper usually disclosed itself; for they did nothing but cough, and therefore they always kill'd those sheep first: Now, if we allow that the cold air is so prejudicial to the lungs, we ought not to wonder if such an inconvenience, as a cold should come upon them; yea, M. *Leewenhoek* is of opinion, that in a long cold winter, the lungs may be so much incommoded, that a great fit of sickness, and even death itself, may be the consequence; if we do but consider what a deal of phlegm a person discharges in a cold; and if it be greenish, it is almost a purulent matter, which is discharged by the air-vessels of the lungs; and the disorder may go so far, that a consumption of the lungs may ensue.

M. *Leewenhoek* took a fine piece of cambric, in which he put a small quantity of strong, and well pounded cinnamon, and tying it up, he plac'd it in a glass-tube, having fasten'd to the cambric a string to pull it out by; then putting his mouth to the extremity of the tube, and drawing in his breath, he could

could plainly perceive the invisible exhaling particles of the cinnamon to descend into his lungs; we cannot say that this cinnamon, being thus deriv'd into the pipes of the lungs, does strengthen the heart, but rather the lungs, unless we affirm that the one partakes of the advantages of the other.

On the 19th of September 1701, it rain'd a little while about noon; whereupon M. *Leeuwenhoeck* intercepted some of the water in a *China* basin, made as clean as possible; this water he put into a glass-tube, in order to try whether there were any *Animalcula* therein; he view'd this water several days together, and could discover abundance of small atoms of dust, or particles that were floating in the air, and consisting of exceeding small parts of burnt wood, or charcoal; wherein he perceiv'd the horizontal and ascending vessels, as also a very small piece of straw, and several blackish particles, which he imagin'd to be conglomerated atoms of smoke, proceeding from the coals which brewers and smiths use; and among these there was an odd phenomenon, made up of little round bubbles that were congeal'd together, like the little stars of snow in winter; but he could meet with no *Animalcula* till the 28th of September; at which time he discover'd exceeding small ones; that one while fasten'd themselves to the sides of the glass, and then swam in the water with a tremulous motion; these *Animalcula* were so very small, and the glass-tube so thick, that M. *Leeuwenhoeck* could hardly see them, and the more, because they were as pellucid as the glass itself; their bodies were twice as long as they were big, and both extremities were tapering or dwindled into a small point; from the 10th of October to the 14th he could find no *Animalcula* alive in the water, tho' he examin'd it very carefully; whereas M. *Leeuwenhoeck* us'd only to observe the upper part of the water in the glass-tube, now on the 15th he turned his speculations towards the bottom of the said tube, which was 4 inches long and $\frac{1}{2}$ an inch in diameter; and here he could perceive abundance of those *Animalcula*, some sitting on the sides of the glass, and others swimming in shoals together; for when one of them stirr'd, all the rest, that were near, moved also; not content with these observations (because it was possible that there had been water in the tube before, and that from thence these *Animalcula* might have proceeded) he took another tube that had lain dry near 20 years in a chest, and where he was well assur'd, that neither water, nor any other matter had been put, excepting air, and such atoms as are always floating therein; on the 18th
it

it rained in the morning, after which there had been very stormy weather for several days; he twice threw away the rain-water he intercepted in a *China* basin, but the third time he put it into a glass-tube; M. *Leewenboeck* view'd this last water several days; but notwithstanding all the pains he took, he could not discover any thing that had life therein; tho' it is true, he saw several small particles fix'd to the sides of the glass, that came very near in figure, and size to the afore-mentioned *Animalcula*; yet on the 24th, he plainly discover'd three of them running on the glass, and swimming in the water, not in a straight line, but in circles and windings, and next day he could perceive in ten different places some of the *Animalcula* running, and others swimming, and that as distinctly, as when we see with the naked eye those *Animalcula* commonly call'd water-flies, swimming in ordinary brooks and canals; M. *Leewenboeck* could now observe against the sides of the glass, in the compass of a large grain of sand, above an hundred particles that were of the size of the aforesaid *Animalcula*; which particles he view'd several times in order to see, if possible, whether they were living animals, or whether there were any thereabouts; but with all this circumspection, he could discover nothing till the 28 of the said month, at which time he perceived 25 *Animalcula* proceeding from the last mention'd particles, which swam and ran about the sides of the glass; and then he also observ'd two sorts of these *Animalcula*; the smallest sort appear'd to him sometimes shining, and sometimes not, which appearance M. *Leewenboeck* imagin'd might proceed from the light reflected from the smooth backs of these animals; and this last sort had quite a different motion in swimming, from those others which were somewhat bigger; in the remaining particles that stuck to the sides of the tube, he could perceive no alteration; he further observ'd the said water several days after, and he saw the smallest sort of these *Animalcula* in vast numbers, wherever he cast his eye, either swimming, or running about the sides of the tube; and whereas M. *Leewenboeck* held the tube full of water in his hand, and consequently put the water in a gentle kind of motion, he could perceive that the stream would often be too strong for these *Animalcula*, and carry them along with it; and the chiefest difference he could find between these *Animalcula*, and the inanimate particles which he also observ'd in the water, and which were very like the other, was that the former made small angles in swimming; whereas, the latter always

always mov'd in a streight line: M. *Leeuwenhoeck* also observ'd, that when he put water into a glass-tube that had never been wetted, abundance of air-bubbles appeared, which stay'd a little while on the glass, and then vanished; that he might be the better satisfied in this matter, on the 6th of *November* he took a new glass-tube, and tho' he had very carefully shut it up, and cover'd it close, he could see abundance of small particles therein; on the same day it rain'd again, and he intercepted the water as before, and put it into the glass-tube, to see whether there were any air-bubbles, and whether they would disappear like the other; he observ'd the water several times, even after it had been four hours in the tube, and in that time discover'd but two or three air-bubbles, which were in a dry particle, from whence the air seem'd to proceed; he placed the aforesaid tube perpendicularly, and another obliquely, almost horizontally, only that the orifice was rais'd a little higher, that the water might not run out, and that the air-bubbles might keep their place in the uppermost parts of the tube; after the space of 10 hours, he saw a great number of air-bubbles, that were for the most part fastened to the said atoms; and whereas no dry particles, nor any other that have air included in them, can admit of water, till the air is first dislodged; this rule holds also in the particles that are found in the glass-tube; but, some of the air-bubbles were 100, and others several 100 times bigger than the atoms to which they were fixed; next day, in the morning, he could perceive but four very small air-bubbles, and a few hours after they were all gone; M. *Leeuwenhoeck* viewed this water till the 14th of *November*, but could not see any *Animalcula* therein: A certain fisherman brought M. *Leeuwenhoeck* some eels no bigger than a large pin, in some of which, that were of a darkish colour, he could very distinctly see the blood circulate, notwithstanding the exceeding smallness of the vessels; but next day viewing one of those little animals, that was changed almost white, he could hardly see the circulation of the blood, which, even in the largest vessels (by reason of the few globules therein) had scarcely any tincture of red.

Roman Coins and other Observables in Lincolnshire; by Mr. Thoresby. Phil. Trans. N^o 279. p. 1156.

ONE *Edward Lenton*, being about to fence in a haystack, and digging a grip for that purpose about half a yard deep, he struck his spade upon a pot, which when he

broke, he found therein 36 pounds weight of old *Roman* copper coins; the pieces had been set in rows edge-ways one by another, and stuck so together with the verdigrease, or rust of copper, that several requir'd a chissel, or some such thing to separate them; but being separated, cleaned, and brightened, the heads, or figures of all, or most of them, were very fair, (some as if newly stamp'd) and the inscriptions of several were very legible; the place where they were found, was in the midst of the largest flat, or level, in *England*, and in a ground that for several years past used to be cover'd with water in winter, and overgrown with reeds in summer; it is about a mile and a half south and by west from *Fleet-church*, and as far south and by east from *Holbeach*; there are no banks nor hillocks, old works, nor ruins to be seen near it, nor the remains of any thing extraordinary therein; only about two or three miles off there is an old sea-bank, which *Dugdale* from a passage in *Tacitus*, takes to have been cast up by the *Roman* soldiery; but all is as level as the sea, and an entire low country, producing a coarse flaggy grass for the most part round about it; the pot, which was narrowest at the top and bottom, but thicker in the middle, had an inscription round it, which, tho' it seem'd in some of the sherds to be fair at first sight, yet was not legible.

Near the river *Welland*, that runs thro' the town of *Spalding* in *Lincolnshire*, at the depth of about eight or ten foot, there were *Ferrets* found, as they call them, to prop up the old river bank; as also, the head of a tunnel that emptied the land water into this river; and at about 20 or 30 yards distance from this river, there were dug up, at the like depth, several old boats; all which shew that the river was formerly, either much wider than it is now, or ran in another channel, or both; on the north-west side of the river, and more upwards in the town, were dug up, about the afore-mentioned depth, the remains of old *Tan-vats*, or pits; a great quantity of ox-horns, shoe-soles, and the very tanners knobs, &c. which shews, that the surface of the country lay formerly much lower than it does now, and has been raised by the sea's throwing in sand on the maritime parts (which are now mostly inhabited) and by the moor or rotted sedge in the fenny parts next the high country; the whole level is about 50 miles in length, and 30 miles over in the broadest parts; no record, either printed or manuscript, or tradition whatsoever, inform us, when these mutations happened.

At

At the laying of a new sluice, or gout, as they call it, at the end of *Hamorebeck*, at its fall into *Boston* haven, upon taking up the foundation of the old sluice, they met with the roots of trees, several of which issuing from their respective boles, or trunks, spread in the ground; and upon taking up the roots, and the soil they grew in, they met with a solid, gravelly, and stony soil of the high country kind (but black and discoloured, by the change it had undergone) upon which hard bottom they laid the foundation of the new sluice, which was certainly the surface of the old country before it was covered by the sea, and was much deeper than that at *Spalding*, as the land there is at present higher.

Mr. *Thoresby* takes this to be an experimental confirmation of Mr. *Ray*'s sentiments in his *Physico* theological tract, concerning the great changes made in the terraqueous globe; viz. that the great level of fens running thro' *Holland* in *Lincolnshire*, the isle of *Ely* in *Cambridgeshire*, and *Marshland* in *Norfolk*, had been sometimes a part of the sea, which by degrees had been raised up by the mud and soil, carried down by floods from the upper grounds, subsiding there.

Strange Epileptic Fits; by Dr. Leigh. Phil. Trans. N^o 280.
P. 1174.

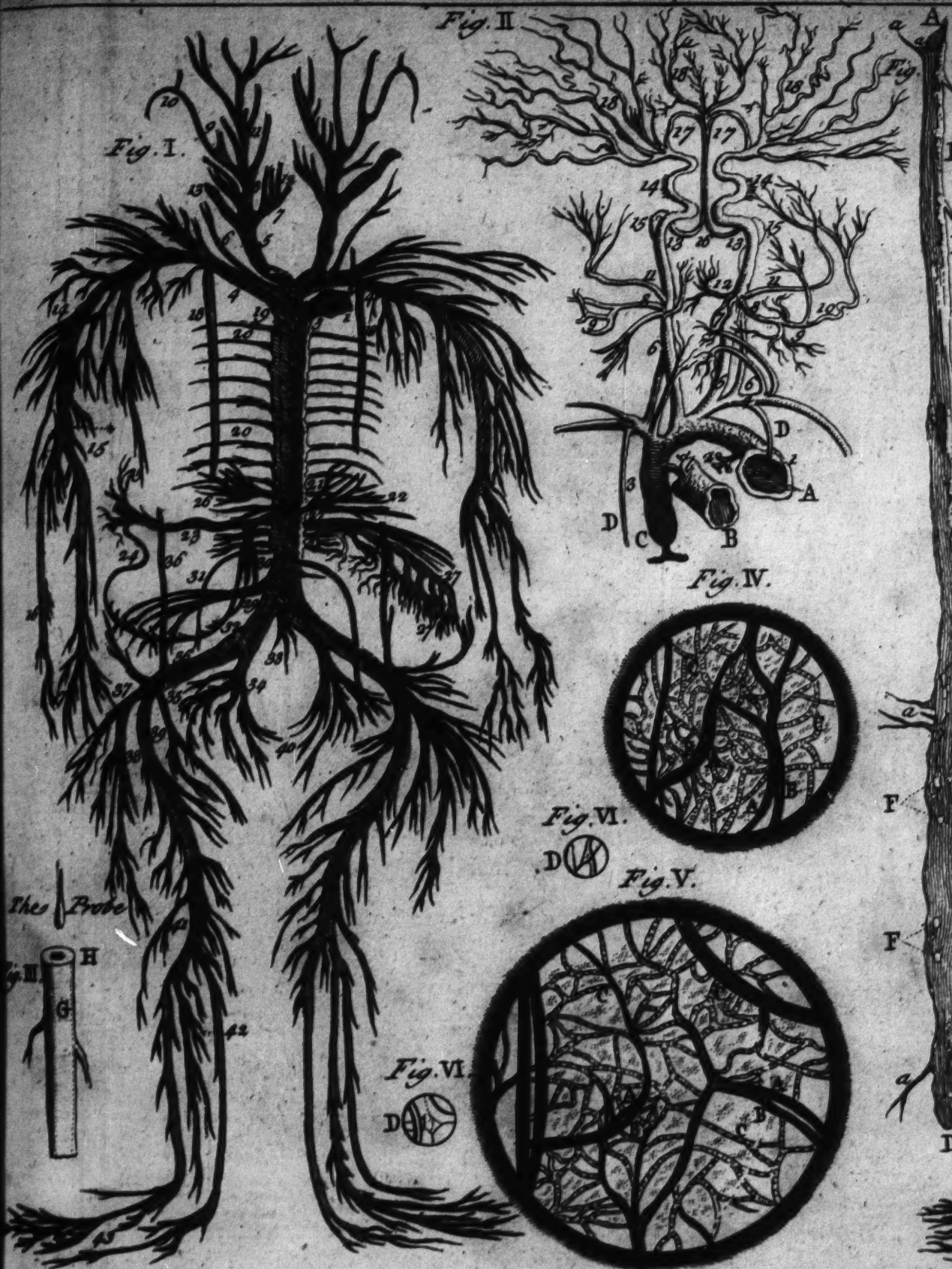
IN 1702, there was an epidemical fever, attended with very surprising symptoms; in the beginning, the patient was frequently attack'd with the *Colica Ventriculi*, convulsions in several parts, sometimes violent vomitings, a dysentery, the jaundice, and in several patients there was a suppression of urine; and what urine was made, was highly saturated with choler; about the seat of the distemper, there appeared large purple spots, and on each side thereof two large blisters, which continued three or four days; these blisters appeared about the spots in such a manner, that they might in some measure be called *Satellites*, or attendants thereon; of these there were in several patients four different eruptions; but the most remarkable instance the Dr. saw in this fever, was, in a boy of *Lyme* in *Cheshire*, about 13 years of age, who was afflicted with the following symptoms; upon the *Crisis*, or turn of the fever, he was seized with an *Aphonia*, and continued speechless six weeks, with the following convulsions; the distemper infested the nerves of both arms and legs, which produced the *Chorea S. Viti*, or *St. Vitus's* dance; both his legs were contracted in such a manner, that no person could reduce them

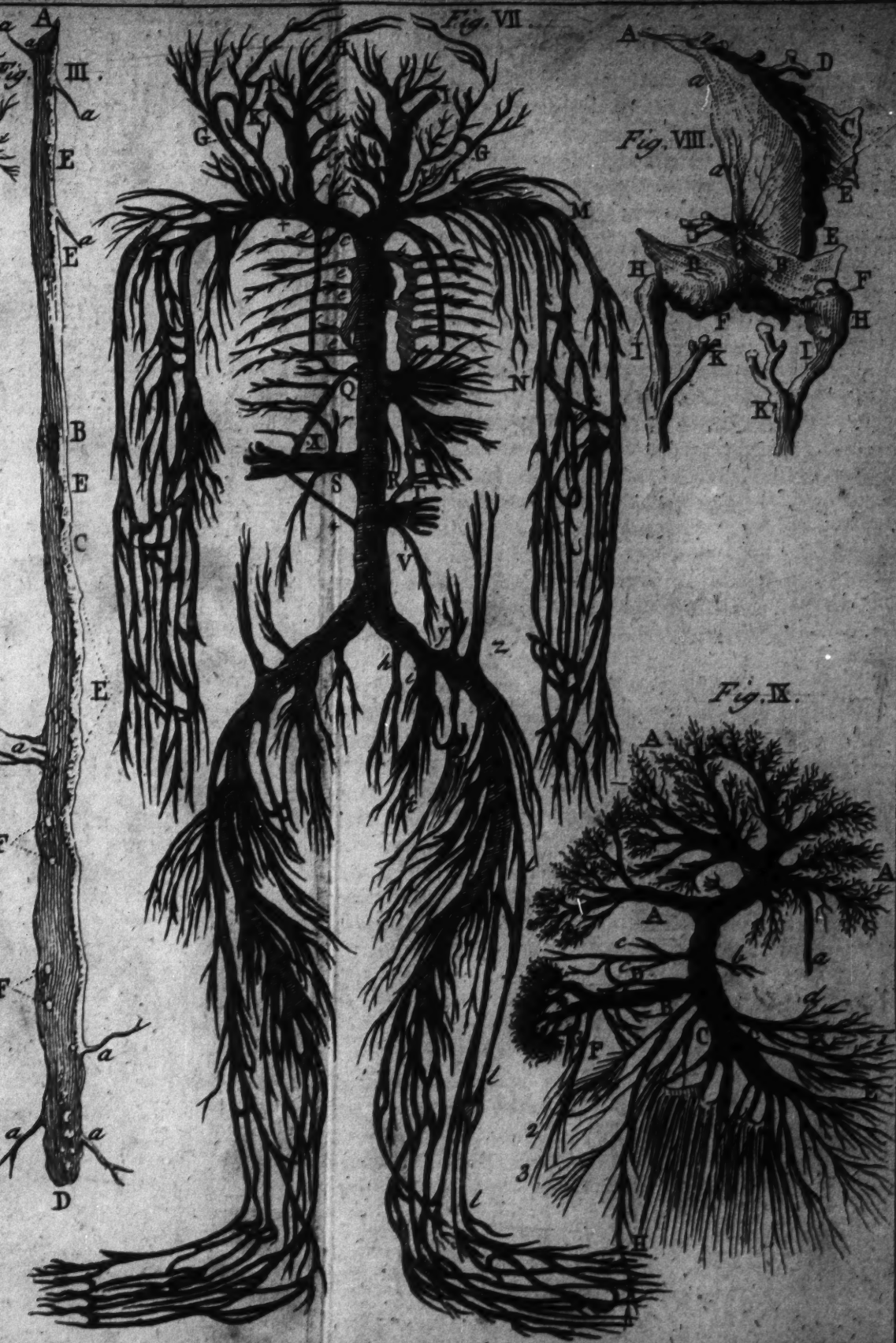
to their natural position; besides these, he had most terrible symptoms, which began thus; the patient could perceive the fits coming on about the *Os Sacrum*, or extremity of the back-bone, and the region of the navel; and then, the disorder, as he imagined, united about the top of his head; immediately after, he fell into such violent convulsions in the *Abdomen*, or lower cavity, that sometimes two or three persons were obliged to lie upon him to keep him in bed, his body being frequently raised from it; after this, the nerves of the lungs were immediately affected, and then he barked in all the usual notes of a dog; sometimes snarling, at other times barking, and at last howling like a hound; afterwards, the nerves of the mandibles were convulsed, and then his jaws clash'd together with such violence, that several of his teeth were beaten out, and then, oftentimes there came a great foam from his mouth; afterwards, he had an exceeding wild look, snatching at any thing near him, and he would have tore off his flesh, had he not been prevented by the persons about him; this made the Dr. conjecture that he might formerly have been bit by a mad dog, which had introduced the *Hydrophobia*; but he was convinc'd to the contrary, by putting a basin of water by him, of which he was not in the least afraid, nor did he attempt to lap it; the Dr. saw him in three of these fits; but, at other times, in these convulsions, he roared like a bull, made a noise like a hog, and sometimes like that of a gosling; all which different sounds, the Dr. took to proceed from the different contractions of the lungs, variously forcing out the air; and consequently, as they were differently convulsed, they form'd various sounds: In a week's time, the Dr. recover'd the boy to his speech; his senses returned, and his convulsions were gone; there were others in this country affected much after the same manner: From this case it is evident, that these distempers are natural, since it cannot be imagined, that a diabolical spirit should be ejected by a regular course of physic.

Figures of the Arteries and Veins explained, with Anatomical and Chirurgical Observations; by Mr. William Cowper. Phil. Transf. N^o 280. p. 1177.

THE schemes of the arteries and veins were done after the vessels themselves were pasted and dried; and which were dissected from adult human bodies, and displayed on tables in the repository of the Royal Society; and were the present of *John Evelyn, Esq*; who gives the following account of them.

‘ Being





Being some years since in *Italy*, and curious of seeing the many repeated dissections at the anatomical theatre at *Padua*, *Cavalier Vesslingius* being then professor, and reading on divers bodies several days, during *Lent*; Dr. *Johanno Athelsteinus Leoncena*, who was then operator, by extracting the veins and other vessels, which contain the blood, spirits, &c. out of human bodies, began to apply and distend them on tables, according to their natural proportion and position; some of these tables being finished by the direction and public approbation of the professor, and several other learned physicians and anatomists, present at these lectures and operations; and understanding that *Leoncena* was about to dispose of his tables, I desired Dr. *Geo. Rogers*, then Consul at *Padua*, for the students of our nation in that university, to purchase and procure them for me; which he did for 150 *Scudi*; with condition that he should add a table more; viz. that of the liver, gastric nerves, and other vessels to complete the fourth.

Mr. *Cowper* finds the arteries here very agreeable, which he drew from the arteries of a *Fœtus* injected with wax; but the figure of the veins differs so much from any extant, as would incline one to suspect all of the subject hitherto published.

It is well known that the arteries are the vessels, which convey the blood from the heart, to all parts of the body; and it is the common practice of nature, in the distribution of these vessels, to supply the parts with blood from the next adjacent trunk, till their ascending and descending trunks become conical, as well as their collateral branches; not that all the trunks and ramifications of arteries are uniform, and become conical in the same manner; nor do all of them pass directly to the parts to which they convey blood; nor do all the parts receive arteries from their neighbouring trunks; for, the trunks of the carotid, vertebral, and splenic arteries in adults, are not only contorted in their progress, but the diameters of their bores are variously dilated in divers parts, especially where they are contorted; but, as these dilatations of their trunks are caused by the resistance which the blood meets with at those angles of inflection, so these enlargements of them afterwards, contribute to retard the protrusion of the blood to the extremities of those arteries; hence it is, that as the arteries in a *Fœtus* are not contorted in such acute angles as in adults, so, their trunks are more conical, and not dilated in divers parts here and there, as in the latter; the trunk of the splenic artery
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has a strait progress in the *Fetus*, and in infants; but in adults Mr. Cowper had constantly found it very much contorted.

The peculiar contrivance of the spermatic arteries in quadrupeds, as well as in men, shews a constant design in nature in taking off that velocity, with which the blood would otherwise pass thro' the glands of the *Testes*; it seems, that for this end, the *Testes* of most animals (especially men, and quadrupeds) hang out of the cavity of the *Abdomen*, that the canals of their blood-vessels may be thereby lengthened; for the spermatic arteries; contrary to all others, arise from the great trunk, at a far greater distance from the *Testes*, than the arteries of any other part of the body; nor would the *Testes*, which are such necessary organs, have been thus exposed to external injuries, if the design of nature in lengthening their blood-vessels had not been very considerable; besides this lengthening of the spermatic arteries, we find nature still contriving other impediments to check the current of the blood in those parts; for this purpose, it seems that the spermatic arteries are lessened at their origin from the trunk of the *Arteria magna* in men, and that the spermatic arteries of quadrupeds are so much contorted, before they reach the *Testes*; the principal design of nature in these different contrivances seems to be, that if the human spermatic arteries were contorted, as in quadrupeds, before they reach the *Testes*, the apertures in the abdominal muscles of men must have been much larger than they now are, and would frequently let the intestines fall into the *Scrotum*; which nevertheless often happens; such ruptures are not so incident to quadrupeds, tho' the passages for their spermatic vessels thro' the abdominal muscles, are much wider than in men, because the position of the trunks of their bodies is horizontal, and their intestines therefore cannot press on the processes of the *Peritoneum*, as in men, who are erect.

After that the circulation of the blood thro' the heart, lungs and large blood-vessels, was demonstrated by Dr. Harvey, it was only guess'd how the extremities of the arteries transmitted the blood to the veins, till M. *Leeuwenhoeck* discovered by his microscopes the continuation of the extremities of those vessels in fishes, frogs, &c. yet some doubt of the like continuations of the extremities of arteries and veins in human bodies, and in quadrupeds, since those animals, it has hitherto been seen in, have been either such fish, or of the amphibious kind, that have but one ventricle in their hearts, and their blood actually cold, excepting in bats, where it appears very obscurely; besides, that the blood in those animals does not circulate with such rapidity as in such whose hearts

hearts have two ventricles; for in all animals that have bi-ventrular hearts, the vessels of the rest of the body return their blood to the heart in equal time and quantity, with those of the lungs, notwithstanding the inequality of their course.

This difference in the principal organs of the circulation of the blood in those animals (on which only these experiments have been hitherto made) induced Mr. Cowper to make some on animals, whose organs differ from the human, in their gross figure only, and not in their intimate structure; for this end Mr. Cowper took a young cat, about 10 or 12 days old, and fastened it to a board, as in vive-section; and making an incision thro' the *Linea alba*, the *Omentum* and intestines were extruded; then causing this animal to be held on the board, under a large double microscope, where a flat glass for receiving of objects was placed horizontally, on which Mr. Cowper expanded the *Omentum* or caul (a light being placed underneath) he saw the globules of the blood move very swiftly in the small vessels, which are only to be seen in the most transparent parts of the membranes of the *Omentum*; but the motion of the blood soon abated, and its globules were withdrawn from the extremities of its blood-vessels, and in a little time became stagnant in their larger branches; Mr. Cowper saw very well this continuation of the extremities of the arteries with the veins, while the blood moved therein, in the *Omentum* of a young lean dog, that was not large; but by the assistance of an instrument he had prepared to expand the mesentery, he saw it there much better; that part having not only larger and clearer spaces than the *Omentum*, but having its blood-vessels distributed more regularly; those who would view with microscopes the transparent parts of animals, will find that the extremities of their arteries and veins are not all equally lessened, tho' united; in the tail of the *Lacerta aquatica*, tadpoles, and of most fish, Mr. Cowper frequently observed several communications between the arteries and veins, in which more than two globules of blood have pass'd a-breast; and in the same area he saw some of those communications so small, that only one globule could pass, and that very slowly before the other; in young fish, particularly in grigs, he frequently observed a communicant branch, so very small, as that only one globule of blood passed it in two or three seconds; at other times he found considerable intervals between the passing of one globule in such a communicant branch, even half a minute, a whole minute, and once in two or three minutes he has seen one globule of blood only pass in a particular tract; the ready passing of injections by the sple-

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nic arteries to the veins, shews that the communications between those vessels are more open than the arteries and veins of other parts; as also injections made into the pulmonic arteries pass to their veins, tho' not altogether so freely, as in the spleen.

On viewing with a microscope the extremities of the pulmonic blood-vessels in a live frog, Mr. Cowper found their communications much larger than those he had formerly seen in the membrane between the toes, and in the feet of the same animal; nor can we reasonably doubt of the like patent communications of the arteries and veins in human lungs, and those of quadrupeds, when we consider, that the blood of the lungs must return to the heart in equal time and quantity, with that of all the parts of the body besides; hence it appears, that the bronchial blood-vessels (first taken notice of by *Ruyseh*) are absolutely necessary, else the parts of the lungs could not receive their nourishment, nor could the glands of the *Bronchiæ* separate their liquor, if they were supplied with blood from the pulmonic blood-vessels, which is so quickly dispatched thro' the lungs; on viewing the membrane, that is between the toes of one of the hinder feet of a live frog, after having frequently taken hold of the same leg of that animal, in order to apply it to the microscope, Mr. Cowper found that membrane very transparent, and without any motion of the globules of the blood therein, as if the part had been dead; but, while he was looking thereon, he saw the globules creep into it by degrees, and at length the blood moved in all the branches of its veins and arteries as before, when no violence had been offered to the part; whilst the blood is thus leisurely creeping thro' the vessels, you may plainly see its globules compressed into oval figures, which are made more or less oblong, by the resistance they meet with by the contraction of the sides of the vessels thro' which they are transmitted; and this Mr. Cowper frequently observed in the tails of the water *Newts*, or lizards; but on examining with a microscope the blood of these animals, and comparing it with the human blood, he found the globules of the lizard's blood incline more to an oval figure, and were as big again as those of human blood; and in like manner he viewed at another time the blood of a small fish: It is not unlikely that a sudden retrocession of blood from the extremities of its vessels often happens, and its circulation in the same vessels, is afterwards carried on without any impediment, on occasion of some passions of the mind, *deliquiums* by the effusion of blood, or otherwise; but if the blood is once become stagnant in its vessels, especially the arteries, the part is in no
small

small danger of a mortification; unless its neighbouring vessels, which enjoy a circulation, propel the stagnant blood, so as to escape by the sides of the vessels that retained it: Experience assures us, that in bruises where the blood is extravasated, it goes off either by transcolation, or else causes an abscess; for there is little reason to suppose that any of the stagnant globules of the blood will be fit to re-unite with the circulating mass: But that the blood after stagnation in its vessels will sometimes pass their sides, appeared to Mr. Cowper from the following experiment;

On viewing the mesentery of a dog when alive, wherein he had before seen the blood passing the extremities of the arteries and veins, he considered how he might preserve the blood in its vessels, that he might any time afterwards see it in their extremities, when stagnant; for this end he caused several parts of the mesentery to be tied on so many pieces of small round pill-boxes, cut transversely like little hoops, on which, portions of the mesentery were extended like the head of a drum; and on viewing them afterwards with his microscope, he found the extremities and branches of the blood-vessels charged with blood, which before appeared in motion; on putting one of these expanded parts of the mesentery in water, the stagnant blood in its vessels disappeared; but on just immersing another of those pieces in water, Mr. Cowper could with his naked eye see the stagnant blood diffused in the interstices of the blood-vessels, and between the membranes of the mesentery; from hence it is evident, that the blood may after stagnation pass the sides of its vessels, but whether its globules are broken, or what figure renders them fit to pass those pores that are in the sides of the vessels, Mr. Cowper leaves to others to determine.

As the arteries are known to convey the blood, so the veins return it to the heart, and here as in the arteries, we find the common practice of nature, in disposing the branches of the veins to discharge the reflux blood into the next adjacent trunk, and so on to the heart; and as the arteries afford abundance of instances of checks given to the velocity of the blood's current thro' several parts, so the veins supply us with as many artifices to assist its regular return to the heart, as well as favour those contrivances in the arteries; the trunks of the carotid, vertebral, and splenic arteries, are not only variously contorted, but also dilated here and there; so the veins that correspond to those arteries are also variously dilated; the beginnings of the internal jugulars have a bulbous cavity, which are *diverticula* or checks

to the reflux blood in the *Sinus* of the *Dura Mater*, lest it should descend too fast into the jugulars; the like has also been observed by Dr. *Lower* in the vertebral *Sinus*; the splenic vein has divers cells opening into it near its extremities in human bodies; but in quadrupeds the cells open into the trunks of their splenic veins; the spermatic veins do more than equal the length of the arteries of the *Testes* in men; their various divisions, several inosculations and valves, are admirably contrived to suspend the weight of the blood, in order to discharge it into the larger trunks of the veins; and were it not that the reflux blood from the *Testes* is a *Pondus* to the influent blood from the arteries, and still lessens its current in the *Testes*; these spermatic veins, like those of other parts, might have discharged their blood into the next adjacent trunk: Who can help being surpris'd at the art of nature, in contriving the veins that convey part of the reflux blood from the lower parts of the body, when we consider, the necessity of placing the human heart, as well as that of most quadrupeds, so far from the center of the body towards its upper part? For that end it is necessary that the large trunks of the veins and arteries should not associate with each other; for if all the blood sent into the lower parts, by the descending trunk of the *Aorta*, should return again to the heart by one single trunk, as it is sent out from thence, the weight of so much blood in the ascending trunk of the *Vena Cava* would oppose the force the heart could give it from the arteries, and hinder its ascent; for this reason the *Vena Azygos*, or *sine pari*, is contrived to convey the blood sent to the muscles of the back and *Thorax* into the descending trunk of the *Vena Cava*, above the heart; hence it is evident, that more blood comes into the heart, by the descending or upper trunk of the *Vena Cava*, than passes out by the ascending trunks of the *Aorta*; nor does this quantity of blood, conveyed to the heart by the superior trunk of the *Cava*, seem without some other design in nature, besides transporting it thither to free the inferior trunk from its weight; but perhaps it was necessary so much blood should be ready there to join with the chyle, for its better mixture, before it reaches the right auricle of the heart; Mr. *Cowper* discovered a peculiar valve in the lower trunk of the *Vena Cava*, near the right auricle of the heart.

Plate V. Fig. 1. represents the trunks and large branches of the arteries dissected from an adult human body, when display'd and dried. 1. The trunk of the *Aorta* cut from the basis of the heart: 2. That part of it, whence the coronary artery of the heart arises: 3. That part of the *Arteria magna*, where the *Canalis*

Canalis arteriosus of the *Fœtus* terminates, which in an adult, becomes a ligament: 4. 4. That part of the axillary arteries, called by some the subclavian arteries: 5. The left carotid artery, which in this subject seems to arise from a common trunk with the right carotid, and axillary arteries, as in some quadrupeds; 6. The left cervical artery, in this subject arising from the trunk of the *Arteria magna*, as expressed in a figure given by *Bergerus* in the *Acta Eruditorum Anno* 1698, p. 295; but in all the human subjects Mr. *Cowper* had examined, he constantly found them as expressed 6. 6. Fig. 2: 7. The arteries that carry blood to the lower parts of the face, tongue, adjacent muscles and glands. 8. The trunk of the temporal artery, arising from the carotid, and emitting branches to the parotid gland 9, and temples 10, and parts adjacent: 11. The occipital arteries: 12. The arteries that convey blood to the *Fauces*, *Gargareon*, and adjacent muscles: 13. The trunk of the carotid artery cut off, before it is contorted in passing the scull: 14. The trunk of the artery of the arm sending out branches to the adjacent muscles, and parts* that part of this artery, which is sometimes prick'd in letting blood, and causes an aneurism; in which case this trunk of the artery must be bar'd and tied hard above the aneurism; and if it afterwards happen (as has frequently been known) that the flux of blood to the aneurism in the artery is not very much abated, tho' the artery has been tied above; the operator, in that case, must make another ligature on the trunk of the artery below its aneurism; these collateral communications of the trunk of the artery at the bending of the cubit, preserve the circulation of the blood in the cubit, and hand; tho' the trunk is totally compressed both above and below, and the same trunk, afterwards divided between those ligatures; hence it is, that if one ligature, made above the wound in the artery, is not sufficient, but the blood still pours out from below, the patient will sooner recover the action, and strength of the muscles of the cubit, than those in whom the upper ligature proves sufficient; the reason of which is obvious, to any one who considers that the communicant branches must be larger, where the lower ligature is required, than when the superior ligature only is sufficient; these communicant branches, as Mr. *Cowper* has seen them in some subjects, are marked out in this figure by prickt lines.

The two following instances happened, in which the communications of the large trunks of the arteries of the cubit, and arm were remarkable; a boy of 13 years of age, who about 3 weeks before Mr. *Cowper* saw him, had received a wound near

the middle of the cubit, in which the trunk of the artery (marked †) was divided; the surgeon, who was first called, had frequently bound up the wounds, and put a stop to the several discharges of blood (amounting to about 6 or 7 quarts at times) but not without a compress on the trunk of the artery, above the wound; on another impetuous flux, Mr. Cowper was called, who seeing a pretty large quantity discharged, he only bound up the wound, in the same manner as it had been done before, omitting the compress on the trunk of the artery above, and adding a piece of deal-board, upon which the hand and cubit were fastened, to prevent any motions of those parts, as well as of the fingers; three days after, the applications were taken off, and little or no blood appeared; but two or three hours were scarcely elapsed, before Mr. Cowper was alarm'd with notice of a fresh flux; the by-standers being instructed in that case, to compress the trunk of the artery above the cubit, they thereby prevented no small effusion of blood, which must otherwise have happened; Mr. Cowper laid bare the trunk of the artery above the wound as expeditiously as he could, being obliged more than once to let loose the compress above, in order to discover its orifice by the flux of blood; he pass'd a needle with strong waxed thread under the artery, and made a ligature on its trunk, which lay concealed in the interstice of the *Musculus flexor digitorum*, and the *Musculus Ulnaris flexor carpi*; but notwithstanding this ligature on the trunk of the artery above the wound, the blood still flowed from the lower trunk of the divided artery; yet the velocity of its current was so much abated, that it seemed like blood flowing from a vein; he left the wound with a digestive, and the part without a hard bandage; and five weeks afterwards, Mr. Cowper heard that the wound was almost cicatrized.

A boy about eight years of age came to *London* with an aneurism of the left arm, having bled for six weeks before; the tumor was indeed very large, in proportion to so small an arm; after laying the aneurism, or tumor bare, and making a ligature on the superior trunk of the artery (at * in the figure) Mr. Cowper found, on loosening the compress on the superior trunk of the artery, very little abatement of the pulsation of the aneurism; he then passed a ligature in like manner on the trunk of the artery below the tumor, but the pulsation still continued, tho' much abated; he then discovered another trunk of the artery, arising from the lower part of the tumour, on which he also made another ligature, and the pulsation then ceased; however, on cutting off the surface of the *Cystis*, or dilated artery, and

and clearing it of the coagulated blood, there still poured out some fresh blood, which was soon stopped with a common astringent; Mr. Cowper left the part without any other ligature, or hard bandage; 18 days after the operation, the ligatures on the arteries were all taken off, and the pulsation of the artery of the wrist began to be very sensible, no symptoms appearing that threatened any danger: This patient recovered the use of his arm, and was afterwards in perfect health.

15. Represents the division of the trunk of the artery of the arm below the flexure at the cubit; 16 the external artery of the cubit, which causes the pulsation commonly felt near the *Carpus*; 17 the arteries of the hand and fingers; 18 the mammary artery; 19, 19, the descending trunk of the *Arteria magna*; 20 20 the intercostal arteries; 21 the *Arteria celiaca*; 22 the *Arteria hepatica*; 23 the trunk of the *Arteria splenica*; 24 the *Arteria epiploica sinistra*; 25 a branch of an artery, which passes to the bottom of the stomach; 26 the superior coronary branch of the stomach; 27, 27 the superior mesenteric artery; 28, 28 the emulgent arteries; 29 the inferior mesenteric artery; 30, 30 the lumbal arteries; 31, 31 the two spermatic arteries, which seem to arise in this subject at a greater distance from each other, than they do commonly; 32 the *Iliac* artery; 33 the *Arteria sacra*; 34 the internal *Iliac* branch; 35 the external; 36 the epigastric artery; 37 branches of the external *Iliac* artery, passing to the oblique muscles of the *Abdomen*; 38, 38, the arteries that pass to the muscles of the thigh, and *Tibia*; 39 the crural artery; 40 the umbilical artery, with those of the *Penis*; 41 that part of the crural trunk, that passes the ham; 42 the three trunks of the arteries of the leg; 43 the arteries of the foot and toes.

Fig. 2. represents the trunks, and some of the ramifications of the arteries of an adult human body, filled with wax; to shew the variety in nature, and supply the defects of the former figure; 1 the *Aorta*, cut off at the basis of the heart; A the three semi-lunar valves, as they appear, when the heart is in *Diastole*, and hinder the blood's coming back from the arteries into the left ventricle of the heart; B a portion of the trunk of the *Arteria pulmonalis*; *bb* its division before it passes to the right and left lobes of the lungs; C the descending trunk of the *Arteria magna*; DD the internal mammary arteries; 2 the trunk of the coronary cut off; 3 the *Ligamentum arteriosum*, which in a *Fœtus* is the *Canalis arteriosus*, and conveys blood from the pulmonary artery to the great artery; 4 the trunk of the subclavian artery; 5, 5 the carotids; 6, 6 the vertebral arteries;

7, 7 the arteries, which pass to the lower parts of the face, tongue, adjacent muscles and glands; 8, 8 the trunks of the temporal arteries, arising from the carotids, furnishing the parotid glands with branches 9, 9, and the temples 10, 10 &c. 11, 11 the occipital arteries; 12 the arteries of the *Fauces Gargaræon*, &c. 13, 13 the contortion of the carotid arteries, as they pass the basis of the skull; these trunks of the carotid arteries in dogs (and as Mr. Cowper supposes, in most quadrupeds) are very much contorted, before they reach the basis of the skull; on injecting these vessels of that animal with wax, he found those branches of them, which pass to the brain (first clipping the hinder parts of the lower jaw) immediately under its condiloid processes, where those arteries are received in two *Sinus*'s of that bone; which *Sinus*'s may be also seen in the jaw-bones of other quadrupeds, but not in human subjects; 14, 14 those parts of their trunks, that pass by each side of the *Sella Turcica*, whence divers small branches arise, and help to compose the *Rete mirabile*, which is more conspicuous in quadrupeds than in human subjects; 15, 15 the contortions of the vertebral arteries, where their trunks are considerably dilated; 16 the vertebral arteries, as they ascend on the *Medulla Oblongata* towards the annular protuberance, or *Pons Varolii*; 17, 17 the communicant branches of the vertebral and carotid arteries; 18, 18 the arteries of the brain displayed.

Fig. 3. represents one of the trunks of the arteries of the *Tibia*, dissected from the leg of one Mr. Stringer after amputation; he was in his 67th year when this artery was taken from him, and for upwards of 20 years before, he had lost the use of both his legs; and in that time he had been so afflicted with convulsions in them, that neither leg was free a quarter of an hour together, whether sleeping or waking; at length one of his little toes was mortified, which was cut off; not long after more toes of the same foot were also mortified; the convulsions in that leg becoming stronger and quicker, that part of the foot next the toes became rumid and inflamed, the tumor extending itself above the *Malleoli*; a sinuous ulcer passed by the side of one of the metatarsal bones, the extremity of which bone, whence the toe was cut off, lying bare; in this condition Mr. Cowper found the left foot and leg of this gentleman, and finding the leg very chilly, the necessity of parting with it was too evident on the abscession, which was about five or six inches below the knee, Mr. Cowper was surprised to see so little blood come from the arteries; and examining the arteries of the amputated leg, having
before

before discovered the cause of a mortification of a young gentleman's arm, who died soon after an imputation of the part, tho' the gangrene did not appear to reach near the place where the abscision was made, *i. e.* below the ending of the *Musculus Deltoides*; in which case Mr. Cowper found the sides of the trunk of the artery of the arm so thicken'd, that the diameter of its bore was contracted to less than a third part and would scarcely admit a common probe; when he had found the ends of the arteries in the leg above-mention'd, he endeavour'd to pass his probe into one of them; but meeting with some opposition, he suspected he had mistaken the vein for the artery, and that the valves oppos'd the passing of the probe that way; but on further dissection, he clear'd the trunks of both those blood-vessels, and found the veins in their natural state, but the sides of the arteries grown bony or stony; A represents the upper part of the artery cut off in the amputated leg; from A to B the trunk of the artery distended and dried to shew its canal; C that part of the trunk of the artery, which was so contracted by the petrification, or ossification, that a probe could not pass its canal; from C to D the trunk of the artery open'd and expanded; E E the petrifications or ossifications in the sides of the arteries; F F their specks in the lower part of the artery, not so large as in the upper part, and placed at greater distances; *aa*, &c. the branches arising from the trunk of the artery; G a portion of the trunk of the artery of the arm above-mention'd; H the sides of the artery, very much thicken'd, whereby its diameter was diminished in such a manner, that a probe could not pass it.

The ossifications in the coats of the arteries have been frequently observ'd, especially in their large trunks within the cavities of the *Thorax* and *Abdomen*; but never taken notice of in the limbs; nor that such impediments in their canals have been found the cause of mortifications of particular parts, as in the instance above-mention'd; tho' Mr. Cowper does not doubt, but the like has often happen'd in aged persons, especially where the progress of the gangrene is not very swift, and its beginning does not arise from any external cause, the consequences of which are commonly found fatal; when the arteries of one leg, or of any other limb, are so affected, we may well suppose the like in those of other parts, which probably, happened in the case above-mention'd; for tho' no gangrene came on the stump, yet the other foot and its toes began to mortify about six weeks after the amputation, as did the parts about the hips, which were compress'd in lying or sitting, before the patient expir'd.

Fig.

Fig. 4. represents the extremities of the blood-vessels, as they appear with a microscope, while the blood is passing thro' them in the *Omentum* of a live dog; A A the branches of arteries; and B B the veins which associate; C C their lesser branches where they separate from each other, and are united again at their extremities.

Fig. 5. the like appearance in the mesentery of a live dog.

Fig. 6. D D the aræ (that are here view'd thro' a microscope) as they appear to the naked eye.

Fig. 7. represents the trunks of the *Vena Cava*, with their branches, dissected from an adult human body; A A the orifice of the *Vena Cava*, as it appears when cut from the right auricle of the heart; a the orifice of the coronary vein of the heart; B A the superior, or descending trunk of the *Vena Cava*; C C A the inferior or ascending trunk, thus distinguished from the motion of the blood in these trunks, which is contrary to their position; D D the subclavian veins; † that part of the left subclavian vein, where the thoracic duct enters, and discharges itself of its chyle and *Lympha*; b the *Vena Azygos*, with its branches going to the ribs ee; c the superior intercostal veins; dd the internal mammary veins; E E the right and left *Iliac* branches; F F the internal jugular veins; G G the external jugulars; H H the veins, which bring the blood from the lower jaw, and its muscles; I I the trunks of the internal jugulars cut off at the basis of the scull; f the veins of the *Thymus* and *Mediastinum*; gg the veins of the thyrotid glands; h the *Vena sacra*; i the internal *Iliac* branch; k the external; K K the occipital veins; L the right axillary vein; M the cephalic; N the basilic; O the median vein; P the trunk of the veins of the liver; Q the phrenic vein of the left side; R the right phrenic vein; r a large vein from the left *Glandula Renalis*, and adjacent parts; S the left emulgent vein; T the right emulgent, in this subject much lower than the left, which is not usual; V V the two spermatic veins; X X two communicant branches, between the ascending trunk of the *Vena Cava*, and *Vena Azygos*, by which the wind passes into the descending trunk of the *Cava*, when we blow into the ascending at A P C; tho' the trunk at A P C is tied hard on the blow-pipe; * an uncommon branch between the lower trunk of the *Vena Cava*, and the left emulgent vein; y a vein which brings blood from the muscles of the *Abdomen* into the external *Iliac* branch; z the epigastric vein of the right side; l the *Vena Saphena*: The considerable venous trunks, which are wanting in this scheme, are represented Fig. 8. where some of the

the large trunks of the veins, and their *Sinus*'s within the scull are exhibited, with the beginnings of the internal jugular veins, fill'd with wax, and dried together with the *Falx*, &c. A the extremity of the *Falx* cut from the *Crista Galli*; a its lower *Limbus* that touch'd the *Corpus callosum*, as it divides the right hemisphere of the brain from the left, where the fifth *Sinus* passes, which is here dried and disappears; B B the second process of the *Dura Mater*, which supported the hindermost parts of the lobes of the brain, and defended the *Cerebellum* from being press'd upon by those parts of the *Cerebrum*; C a portion of the *Dura Mater* adhering to the longitudinal *Sinus*; D D several trunks of the veins of the brain cut off, before they enter the longitudinal *Sinus*; E E the longitudinal *Sinus*; F F the two lateral *Sinus*'s; G the fourth *Sinus*; g the veins from the *Plexus Choroides*; H H the *Bulbi*, or *Diverticula* at the beginnings of the internal jugular veins; I I the internal jugular veins; K K the trunks of the veins, which convey blood from the lower jaw, and adjacent parts.

Fig. 9. represents the trunks of the *Vena Porta* dissected and display'd; A A the branches of the *Vena Porta* freed from the liver; a the umbilical vein; B the splenic vein; C C the mesenteric branches, which are continued from the intestines; b the trunk of the *Vena pancreatica*, which also receives branches from the *Duodenum*; cc the *Vena Gastrica dextra Coronaria superior*; D the superior coronary vein of the stomach on the left side; E the inferior coronary branch of the stomach on the right side; and F the same coronary vein of the left side, remov'd from their proper situations; from these two last are continu'd the *Vena Epiploica superior dextra* 1, and the *sinistra* 2, with the *media* 3; G the vein call'd *Vas breve*; d the *Vena Duodeni*; H the *Vena Hemorrhoidalis*, arising from the *Rectum* and *Anus*, in this subject discharging itself into the left mesenteric branch; but in other subjects Mr. Cowper found this trunk of the hæmorrhoidal veins ending in the *Ramus Splenicus*; the length of the trunk of this hæmorrhoidal vein, and its progress under the intestines, render it liable to be compress'd, and its reflux blood retarded; whence its branches in the *Intestinum Rectum* & *Anus* become distended with blood, and cause the *Hæmorrhoides Cæcæ* and *Apertæ*, which are frequently attended with imposthumes in the *Anus*, and parts adjacent; to which disorders they are the more incident, not only because these hæmorrhoidal veins, like the rest of the branches of the *Vena Porta*, are without valves, and the blood has an ascending progress

gress therein; as also that the long trunk H is not only expos'd to the compressions made by the intestines in both sexes, but particularly the *Uterus* in women at the time of gestation, especially near the birth, so compresses this trunk, that it is no wonder that we find women more afflicted with the hæmorrhoids at that time than at any other; the *Iliac* veins and the lymphæducts that accompany them are also expos'd to the like compression in women with child, whence the veins of the legs and thighs become varicose, and these limbs are so frequently swell'd; which intumescence in an instance Mr. *Cowper* was acquainted with, prov'd so great, that at length the abdominal teguments were vastly extended; but the patient recover'd, beyond the expectation of some, on the delivery of two large children.

An Account of the Island of Chusan in China, &c. by Dr. Cunningham. Phil. Trans. N° 280. p. 1201.

WE arriv'd at the island of *Borneo* on the 17th of *July* 1701, where we staid but two days, the season of the year being far spent; and from thence we made the best of our way thro' the streights of *Banca*, with favourable winds and weather, 'till we came on the coast of *China*, which was on the 13th of *August*; then we had variable winds, which carried us a-breast of *Emuy* the 19th following; at which time, the north-east winds setting in fresh, put us in great fear of losing our passage; whereupon, we were obliged to turn it up against the wind and current all the way, the weather favouring us so, that we had out our top-sails only, else we should have lost more ground in one day, than we could have gain'd in eight; the last of *August* we came to an anchor under the *Crocodile Islands*, both to shelter us from the bad weather (which is generally expected on this coast at new and full-moon, and has been fatal to several ships) as also to look for fresh water, which was now grown scarce with us, not having recruited since we came from the *Cape of Good Hope*; these are three small islands lying in the latitude of 26 degrees, about 6 leagues from the river of *Hocksiu*; on two of which we found very good fresh water, with a convenient watering place on the south-west side of the innermost of the three; by the assistance of a few *Chinese* fishermen, we procur'd some fresh provisions from the main land; while we lay here, on the 5th of *September* we had a sudden short shift of the *Monsoon* to S. W. the fury of which others felt, in coming at the same time upon the coast of *China*; the 8th we put to sea again, turning to windward day and night, without all the islands, which are very

very numerous along this coast, to which we were altogether strangers beyond *Emuy*; and the hydrography thereof is hitherto so imperfect, that there was no trusting to our charts, which made our navigation somewhat more dangerous; however, on the 1st of *October* we got into the latitude of 30 degrees, where we came to an anchor near the land, till we found the way by boat to *Chusan*, about 12 leagues within the islands, from whence we had a pilot, who carried us safely thither on the 11th of *October*; upon this island the *Chinese* granted us a settlement, and liberty of trade, but not to *Ning-po*, which is 6 or 8 hours sail to the westward, and all the way amongst islands; this being the largest, is 8 or 9 leagues in length from east to west, and 4 or 5 leagues in breadth; about 3 leagues from that point of the main-land, called *Cape Liampo* by the *Portuguese*, but *Khi-tu* by the *Chinese*; at the west end of this island is the harbour, which is very safe and convenient, and where the ships ride within call of the factory, which is built close upon the shore on a low plain valley, with near 200 houses about it for the benefit of trade; inhabited by men, whose jealousy has not yet suffered them to let their wives dwell here; for the town where they are, is 3 quarters of a mile further from the shore, surrounded with a fine stone-wall, about 3 miles in circumference, mounted with 22 square bastions plac'd at unequal distances, besides 4 great gates, on which are planted a few old iron-guns, seldom or never us'd; the houses within the wall are very meanly built; here the *Chumpeen*, or governour of the island lives, and between 3 or 4000 beggarly inhabitants, mostly soldiers and fishermen; for the trade of this place being newly set up, has not yet brought any considerable merchants hither; the island in general abounds with all sorts of provisions, such as cows, buffalo's, goats, deer, wild and tame hogs, geese, ducks, hens, rice, wheat, calavances, coleworts, turnips, potatoes, carrots, beets and spinage; and as to merchandise, there is none, but what comes from *Ning-po*, *Hangcheu*, *Nankin*, and the inland towns; here also tea grows in great plenty upon the tops of the hills, but it is not in that esteem with what grows on more mountainous islands; tho' this island is pretty well peopled, yet it is far from what it was in *F. Martinius's* time, when he describes *Cheusan*; and *Dr. Cunningham* supposes, that the superstitious pilgrimages thereto, mention'd by *F. Martinius*, must be meant of the island *Pou-to*, which lies 9 leagues from hence, and 3 miles to the eastward of this island; this *Pou-to* is a small island, about 5 leagues round, at the east-end whereof is a place famous for the superstitious pil-

pilgrimages made thither for the space of 1100 years; it is inhabited only by *Bonzes*, to the number of 3000, all of the sect called *Hoshang*, or unmarried *Bonzes*, who lead a *Pythagorean* life; and there they have built 400 *Pagodes*, two of which are considerable for their largeness and finery, having been lately cover'd with green and yellow tiles, brought from the Emperor's palace at *Nankin*, and adorned within with stately idols finely carved and gilded, the chief of which is the idol *Quon-em*; to these two *Pagodes* belong two chief priests, who govern all the rest, they have several roads and avenues cut thro' the island, some of which are paved with flag-stones, and shaded with trees planted on each side; their dwellings are the best the Dr. saw in those parts, all which are maintain'd by charitable devotions; and the *Junks*, who go from *Ning-po*, and this place to *Japan*, touch there both going and coming, to make their offerings for their good success; there is another island called *Kim-tong*, five leagues from hence in the way to *Ning-po*, whither, they say, several *Mandarins* retire to live a quiet life, after they have resigned their employments; on that island there are also said to be silver-mines, but prohibited to be opened; the rest of the circumjacent islands are either desert, or but poorly inhabited by a few fishermen; but all of them are stored with abundance of deer; for, it is not long since that this island of *Chusan* began to be peopled; it is true, that in *Martinus's* days, about 50 years ago, it was very populous for the space of three or four years, at which time the fury of the *Tartarian* conquest was so great, that they left it desolate, sparing not so much as the mulberry-trees, (for then they made a great deal of raw silk here) and in this condition it continued till about 18 years ago, that the walls of the present fort, or town, were built by the governor *Ting-kai*, as a garrison to expel some pirates, who had taken shelter here; about 14 years ago, the island beginning to be peopled, there was a *Chumpeen*, or general, sent to govern it for three years, to whom succeeded the late *Chumpeen*, (who procured the opening of this port to strangers) whose government continued till April 1701, being translated to be *Chumpeen* of *Tien-cing Wei* near to *Pekin*, and was succeeded by the present *Chumpeen*, who is son to the old *Chunkoon* of *Emuy*.

They have no other arts or manufactures here, than making of lacker'd ware; they begin to plant mulberry-trees, to breed up worms for the production of raw silk; and they make some tea, but chiefly for their own use; the three sorts of tea,

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commonly carried to *England* are all from the same plant, only the season of the year, and the soil make the difference; the *Bohea*, or *Voiii*, so call'd from some mountains in the province of *Fokien*, where it is chiefly made, is the very first bud, gather'd in the beginning of *March*, and dried in the shade; the *Bing* tea is the second growth in *April*; and *Singlo* the last in *May*, and *June*, both dried a little in tatches, or pans over the fire; the tea shrub, being an ever-green, is in flower from *October* to *January*, and the seed is ripe in *September* and *October* following, so that a person may gather both flowers and seed at the same time; but for one seed that is fresh and full, there are 100 bad; these make up the two sorts of fruit in *Le Compte's* description of tea; as for his other sort, which he calls slymic pease, they are nothing but the young buds of the flowers not yet open; its seed-vessels are really tri-capsular, each *Capsula* or case containing one nut, or seed; and tho' only one or two *Capsula* come to perfection, yet the vestiges of the rest may be discern'd; in several places of this island it grows without any culture, in a dry gravelly soil, on the sides of hills: *Le Compte* is mistaken in saying p. 96. that the *Chinese* are entirely strangers to the art of grafting; for *Dr. Cunningham* has seen a great many of his paradoxical tallow-trees grafted here, besides some other trees; when they graft they do not slit the stock as we do, but cut a small slice off the outside of the stock, to which they apply the graft, being cut sloping on one side, to correspond with the stock, and bringing up the bark of the slice upon the outside of the graft; they tie all together, and cover it with straw, and mud, as we do. The commentator on *Magalhen* seems to be doubtful as to the length of the *Chinese Che*, or cubit; here they have two sorts, one of 13 $\frac{7}{10}$ *English* inches, which the merchants commonly use; the other is 11 inches, which is us'd by carpenters, as also in geographical measures; tho' *F. Martinus* is censur'd by *F. Magalhen* for spelling a great many *Chinese* words with *ng*, which the *Portuguese*, and others have done with *m*; yet, his way is more agreeable to the *English* pronunciation, only that in some words the *g* may be left out, as in *Pekin Nankin*, &c.

Dr. Cunningham having made an enquiry about *Martinus's* account of sowing their fields at *Vencken* with oyster-shells, in order to make new ones grow up; the Doctor was told, that after they have taken out the fish, they sprinkle the shells with urine; then putting them into the water again,
new

new oysters grew upon the aforesaid shells; *Martinius* says, he could never find a *Latin* name for the *Fula Magorin* of the *Portuguese*; but the Dr. is sure that it is the same with the *Syringa Arabica flore pleno albo* in *Parkinson*; he also says, that the *Kieu-yeu* or tallow-tree bears a white flower like a cherry-tree; but all that the Dr. saw here bore a spike of small yellow flowers like the *Julus* of a *Salix*; the bean, or *Mandarin-broth*, so frequently mention'd in the *Dutch* embassy, and other authors, is only an emulsion made of the seed of *Sesamum*, and hot water; their chief employments here are fishing and agriculture; in fishing they use several sorts of nets and lines as we do; but because they have large banks of mud in some places, the fishermen, in order to go the more easily thereon, have contriv'd a small frame about 3 or 4 foot long, not much larger than a hen-trough, a little elevated at each end, in which he rests upon one knee, leaning his arms upon a cross stick, rais'd as high as his breast, and putting out the other foot often upon the mud, he pushes forwards his frame thereon, and so carries himself along in it; as to their agriculture, all their fields, (where any thing is planted) whether high or low, are divided into such plots, as may retain the water on them, when they please; they plough up their ground with one buffalo, or one cow; they prepare the fields very well, where they are to sow rice, by clearing it of all manner of weeds, moistening it to a pulp; and smoothing it with a frame drawn a-cross; on which they sow the rice very thick, and cover it only with water for 2 or 3 inches high; and when it has grown 6 or 8 inches long, they pull it up by the roots, by tufts in a straight line, and transplant it into those fields overflown with water; and where a field is subject to weeds, when the water dries up, they prevent their growth, by overturning the mud with their hands in the interstices where the rice is planted; when they sow wheat, barley, pulse, and other grain, they grub up some superficial soil, grass, and roots, and burn all together with some straw; this soil being sifted fine, they mix with the seed, which they sow in holes made in a straight line, and so it grows up in tufts, as the rice does, the field being divided into beds, and harrow'd over, both before, and after the seed is sown; this makes them somewhat resemble garden-grounds; tho' they meliorate their fields, where they sow rice, only by letting the water on them; yet, for other grain, where the ground requires it, they make much use of dung, human excrement, ashes, &c. In watering their fields here, they use the

the same instrument, as that mention'd by *Martinius* in the preface to his *Atlas*, being all of wood, and the contrivance the same with that of a chain-pump: Their method of making of salt is thus; all the shores here being mud, instead of sand; in the summer-season they pare off the superficial soil, which has been overflown with salt-water, and lay it up in heaps; when they are to use it, they dry it in the sun, rubbing it fine; then digging a pit, they cover the bottom thereof with straw, at which thro' the sides of the pit, they pass a hollow cane, that leads into a jar, which stands below the level of the bottom of the pit; they fill the pits almost full with the aforesaid soil, and pour salt-water thereon, till it is cover'd 2 or three inches high, and this drains thro' into the said jar, and is afterwards boil'd into salt.

Dr. *Cunningham* saw here a root call'd *Hu-chu-u*, which he takes to be the same with that brought from *China* by *F. Fontaney*; to which the natives ascribe wonderful properties, as that of prolonging life, turning grey hairs into black, by drinking its infusion for some time; insomuch, that they say, it is to be valu'd from 10 to a 1000, or 2000 *Tael* a single root; for, the larger it is, the greater is its value, and efficacy; it is mention'd in *Clyer's Medicina Sinica* N° 84, under the name of *Hoxeu-u*, according to the *Portuguese* orthography. The story of its discovery is this; once upon a time a certain person going a simpling upon the mountains, by accident fell into such a deep valley, that he could by no means get out again; whereupon looking about for somewhat to sustain his life, in this melancholy condition, he espied this root, of which he made trial; and he found that in eating thereof, it serv'd him both for provisions and cloathing, by keeping his body in such a temperature, that the injuries of the weather had no influence upon him, during his stay there, which was some hundred of years; till at last, an earth-quake happen'd in that place, whereby the mountains were rent, and he found out a passage to his house, from whence he had been so long absent; but the several alterations, that happen'd there in such a space of time, would not permit them to give credit to his story; till consulting the annals of their family, which gave an account of one of them lost at that time, they were confirm'd in the truth of his relation.

The internal Use of Cantharides; by Mr. Yonge. Phil. Trans. N° 280. p. 1210.

A Gentlewoman 54 years old, who for a long time had been mightily afflicted with frequent fits of the stone, and commonly brought away several stones with the gravel, &c. grew dropfical, of which being cur'd, she fell into a total suppression of urine, which for several days baffled all remedies; in this desperate condition, about 4 in the afternoon, on the 5th day of the disease Mr. Yonge gave her 5 *Cantharides*, (without heads, wings, or legs) that weigh'd 4 grains and a half; and with as much camphire, and a little conserve, he made them into 2 pills, or bolus's; next morning Mr. Yonge found no effect, either good or bad; but about noon, the flood came, and continu'd above 48 hours, bringing off in that time much more urine, than could have been expected from her during all the time of the obstruction; there came away some gravel, and fabulous matter, but no stones; nor was the stomach, bladder, or other bowels affected as usual, upon the internal use of those insects; but they operated so quietly, as if only two doses of *Sal Prunellæ* had been administer'd: In several cases Mr. Yonge, had often given it with success, and that without the *Dysuria*, and other painful accidents, which attend the internal (oftentimes the external) use of this medicine; tho' he mix'd no camphire therewith; only washing it down with large draughts of posset, ptisan, emulsions, or water-gruel, which in the lady's case he forbore, because of her dropfical disposition, and only us'd a draught or two of middling ale, impregnated with broom, juniper-berries, *Daucus* seeds, &c. The form in which he was wont to administer it, was that of a soft pill or bolus, compos'd of 3 *Cantharides prepar. Troch. & Myrrhat. Oss; Sem. Ammeos gr. vi Rob. Cynosb. q. s.* This is very serviceable in stubborn suppressions of the *Lochia & Menstrua*, in difficult child-birth, and retention of the *Secundines*; what heat, or pain it causes in the neck of the bladder, is much short of what proceeds from applying an epispastic to the back.

A young man gave a girl a plumb-cake, wherein powder'd *Cantharides* had been mix'd; she eat part of it, and gave three others of the family where she liv'd, a share; they were soon afflicted with a burning in the stomach, bloody, and scalding urine, and great pain in the back; Mr. Yonge cur'd them

them all in a short time with powder of *Ammeos* and *Sal Prunelle*, and emulsions of *Aq. Sperm. Ran.* &c. and by a piece of the cake that remained, Mr. *Tonge* supposed that 8 or 9 grains of the *Cantharides* must have fallen to the share of each.

Olaus Borrichius Act. Med. Barthol. Vol. 4. Obs. 80. gives a chemical and microscopical *Examen* of these flies; he says, that their parts, separated by chemistry, do not affect the skin; that the points of their particles wound it; and that the volatile salt insinuates thro' those little perforations; he also attempts to shew how they cause a *Dysuria*, and offend the bladder, when applied to a part so remote, as the back or neck. *Vide Vol. 3. Obs. 89.*

Experiments on Vegetation; by Mr. Abraham de la Pryme. Phil. Trans. N^o 281. p. 1214.

SOME have made experiments of the meliorating, fertilizing, and multiplying of grain, by steeping them in divers liquors; *Digby* mentions a barley-plant arising from a single grain, which, by steeping and watering it with salt-petre dissolved in common water, produced 249 stalks, and above 18000 grains; and the last edition of *Cambden* mentions a thing very observable, that the corn sown in a field in *Cornwal*, after a great battle in the time of the civil war, produc'd four or five ears on each stalk.

On the 22d of *March* 1699, Mr. *de la Pryme* laid to steep in brimstone-water, a pea, a barley, and a wheat-corn; in allum-water a pea, a wheat, a barley, and an oat-corn; and the same in an old solution of salt of tartar; in the *Caput Mortuum* of *Sal Armoniac* dissolved in urine; in a solution of the salt of walls; in a solution of salt-petre; in a solution of *Noftoc*, or star-gelly, and in urine; having steeped them thus for five days and five nights, he set them in a good soil in a garden, against a north-wall, full in the sun; on the 27th of the same month, after a rainy night, together with a pea, a wheat, a barley, and an oat-corn unsteep'd; upon the 10th of *April* following, he found that some were just come up, and others not; the pea, barley, and wheat steeped in brimstone-water came all up together; the pea steeped in allum-water was very big, and swelled, but did not so much as sprout; but the barley, wheat, and oat corns were above ground; the pea steeped in the old solution of salt of tartar was half come up, the wheat scarcely sprouted, but the barley and the oat corns

were quite up; the pea, the wheat, the barley, and the oat corns steeped in the *Caput Mortuum* of *Sal Armoniac* dissolved in urine, were all up together; as also the next row, that were steeped in the solution of the salt of walle; the pea and the wheat steep'd in the solution of salt-petre were about half up, but the barley and oat corns were quite up; none of those, which were steep'd in *Nostoc*, were come up, nor scarcely sprouted; the barley and oat grains steep'd in urine were come up, but the pea and wheat were scarcely sprouted; and to Mr. de la Pryme's surprise, the pea, wheat, barley, and oat-corns, that had not been steep'd at all, were as soon up as any of the former; excepting only the wheat, which was about half up; he had set them all about a finger deep in the ground, and all the time of their growing there was very fine weather: From all which Mr. de la Pryme supposes, that alum-water is contrary to the nature of peas, and retards their growth, but agrees well enough with wheat, barley, and oats; that the solution of salt of tartar is not agreeable to the nature either of peas or wheat, but to that of oats and barley; that the solution of saltpetre had not any of the great virtue he supposed it to have, &c. and that these steepings did not forward any of the said grains in their growth and coming up, but plainly retarded some, or most of them; then, Mr. de la Pryme dug all of them up, except three spires of barley, which he let stand about a foot and a half, or two foot from each other, and they grew and increased so exceedingly, that they had 60, 65, and 67 stalks a-piece, from a single grain and root, with every one an ear, and about 40, or somewhat more corns a-piece in them; which increase proceeded not so much, perhaps, from the grain having been steep'd in any liquor, as from the fertility and goodness of the soil, and their competent distance from each other; he observ'd, that new shoots struck up continually from the root; and that, as in the *East* and *West-Indies*, there are trees that always bear blossoms and flowers, green and ripe fruit at the same time; so here, if the invigorating heat of the sun had not been cool'd, and weaken'd by the approach of the winter season, there constantly would have been new and ripe corn, as also, empty ears on the same root.

The Influence of Respiration on the Motion of the Heart; by Dr. Drake. Phil. Trans. N° 281. p. 1217.

THE learned Dr. *Lower* has so well accounted for the *Systole*, or contraction of the heart from its mechanical structure, that he seems almost to have exhausted the subject; and had he been as happy in discovering the true cause of the *Diastole*, he had left little room for the industry and sagacity of others about this *Viscus*; he ascribes the *Diastole* to a motion of restitution, which is not satisfactory; because, the *Systole* being the proper, and as Dr. *Lower* himself confesses, the only motion of the heart, a state of contraction seems to be its natural state; and consequently, without some external violence, it would have no *Diastole* at all; this will appear more plain, if we consider the circumstance thereof, and its motion, as a muscle, with respect to other muscles: That contraction is the proper action and state of all the muscles, is evident from experience, as well as from reason; for, if any muscle is freed from the power of its antagonist, it is immediately contracted, and is not to be reduced to a state of extension by any action whatever of the will or spirits; thus, if the *Musculi Flexores* of any joint be divided, the *Extensores* of that joint being by that means freed from the contrary action of their antagonists, that joint is immediately extended, without any consent of the will, and in that state it remains; and *vice versa*, if the *Extensores* are divided; from whence it is plain, that the muscles have no restitutive motion, but what they derive from the action of their antagonists, by which they are balanced; thus likewise, the *Sphincters* of the *Gula*, *Anus*, and *Vesica*, having no proper antagonists, are always in a state of contraction, and suffer nothing to pass them, but what is forc'd thro' them by the contrary action of some stronger muscles, which, tho' they are not properly to be call'd antagonists, yet, on all necessary occasions perform the office of such.

That the heart is a muscle, furnished and provided for motion, like other muscles, is demonstrated beyond contradiction by Dr. *Lower*, and others; and, as it is a solitary muscle, without any proper antagonist, and not directly under the power of the will, nor exercising a voluntary motion, it approaches nearest to the *Sphincter* kind, which has only these conditions in common with it; but, in constant and regular alternations of contraction and extension, it differs exceedingly

from all the muscles of the body; this reciprocal *Æstus* of the heart has given the learn'd abundance of trouble, who, finding nothing peculiar in the structure, which should necessarily occasion it, nor any antagonist, whose re-action should produce it, have been extremely perplex'd to find out the cause thereof: Dr. *Drake* observes, that Dr. *Lower*'s account of the *Systole*, however solid and ingenious, has something deficient therein, and his hypothesis of the *Diastole* he takes to be precarious and false; for, this author, having by sound arguments, drawn from the structure and mechanism of the heart, established the certainty of its muscular motion, takes no notice of any assistance that the heart receives from any other part; excepting, from the brain, by means of the 8th pair of nerves: The accurate *Borelli*, in his *Oeconomia Animalis*, computes the motive power of the machine of the heart to be equal to, or to surmount that of a weight of 3000 pounds; the obstacles to the motion of the blood thro' the arteries, he estimates to be equivalent to 180,000 pounds, which is 60 times as much as he rates the force of the heart at; then deducting 45,000 pounds, for the adventitious help of the muscular elastic coat of the arteries, he leaves the heart with a force of 3000 pounds to overcome a resistance of 135,000 pounds; that is, with 1 to remove 45; this stupendous effect, he contents himself to ascribe to the energy of percussion; but, had he proceeded in his calculations to the veins, which he allows to contain constantly a quantity of blood, quadruple to the contents of the arteries, and to which this energy of percussion does either not reach at all, or but very languidly, he probably might have seen a necessity for some other expedient to remove so insuperable a difficulty; this account Dr. *Drake* has taken notice of, purely for the sake of the calculation, which may be of use in the sequel, the account itself being in other respects more defective than Dr. *Lower*'s, to which we will return.

The Dr. appears to have overlook'd something of very great moment and importance in the explication of the action of the heart; for, tho' it should be granted, that the muscular fibres of the heart acted by the nerves, are the immediate instruments of its constriction and *Systole*; yet, it must not be denied, that the intercostal muscles and diaphragm are of great service to aid, and facilitate this contraction, by opening a passage for the blood thro' the lungs; which if denied, it would be an invincible obstacle; nor do they promote it that way only; the manner how they farther assist the heart in its contraction, will appear

appear manifestly, if we consider the different position, situation, and capacity of the blood-vessels of the lungs in the several times of elevation and depression of the *Costæ*; the pulmonary artery rises from the right ventricle of the heart, and runs in one trunk, till it comes to the *Aspera Arteria*, where it is divided, and sends a branch along with each division of the *Aspera Arteria*, according to all the minutest subdivisions thereof, accompanying all the *Bronchia*, in their whole progress thro' the lungs; the pulmonary vein, which empties itself into the left ventricle of the heart, spreads itself on the *Aspera Arteria* and *Bronchia*, in the same manner that the artery does; the necessary consequence of which disposition is, that this artery and vein being co-extended with, and fasten'd to the *Bronchia*, must needs suffer such alteration of its superficial dimensions, as the *Bronchia* do in the elevation or depression of the *Costæ*; while the ribs are in a state of depression (whether before or after a communication with the external air) the annular cartilages of the *Bronchia* shrink into each other, and by that means their dimensions are exceedingly contracted; in a conformity with this condition of the *Bronchia*, the pulmonary artery and vein must also, either by means of their muscular coats, contract themselves to the same dimensions, or lie in folds or corrugations, which is less probable; on the other hand, when the ribs are elevated, and the diaphragm bears downwards, the air rushing into the lungs, extends the cartilaginous rings, and divaricates the branches of the *Trachea*, and thereby extends and divaricates the several divisions of the pulmonary artery and vein, and so lengthens and enlarges their cavities; which enlarging is very considerable, not only upon the account of the addition, which they receive in length thereby, but also upon account of their divarication; for when the ribs are depressed, and the lungs subside, the blood-vessels are not only contracted (as has been already observ'd) but their branches, which are exceeding numerous, approach to each other, and lie in a juxta-position, by which their cavities are very much compressed and streighten'd; but when the ribs are elevated, and the lungs turgid with air, not only the fibres, by which their coats in the opposite state were contracted, are extended; but those innumerable vessels, which, lying before in lines almost parallel, compressed each other, and making an acute angle at their junctures, are divaricated, and separated from each other, and make an obtuse angle, whereby their channels are widened; thus a passage is open'd to the blood, from the right ventricle of the heart

heart to the left, thro' the lungs, to which it could not otherwise be conveyed; and the opposition, which the blood contained in that ventricle, must otherwise have necessarily made to its constriction, is taken off, and the *Systole* thereby facilitated; nor is that all, for, the *Diastole* being caused (as shall be shewn in the sequel) by the force of the blood rushing into the ventricles; this ampliation and extension of the pulmonary artery is a sort of check, or counterpoise to it, and prevents an endeavour towards two contrary actions at once, which must necessarily frustrate both; for, the heart being an elastic, compressible body, whose proper action, which is contraction, depends on the influx of certain fluids into its fibres, or substance; and besides, containing a fluid in its ventricles, or large cavities, in one of which is the mouth of this artery, the action of this vessel must in a great measure resemble that of a *Syringe*, whose extremity is immersed in water; the enlargement, or expansion of the channels of the artery, answering the drawing of the *Embolus*, as the constrictive motion of the muscle of the heart does the pressure of the atmosphere upon the surface of the water; the one making way for the fluid, and the other forcing it to follow, where the resistance is least; in this sense we may allow a sort of attraction to the pulmonary artery, entirely depending upon the action of the intercostal muscles and diaphragm; which therefore, we must confess to be very serviceable and instrumental in promoting the *Systole* of the heart: But, if this author has not observed all the mechanism and contrivance of nature for the *Systole*, or contraction of the heart, much less, has he sufficiently accounted for its *Diastole*, or dilatation; which he ascribes to a motion of restitution of the over-strain'd fibres, which, yet, he confesses are designed for constriction only; it is true, he immediately after joins the influx of the blood, as a concurrent cause; but, from the slight notice he takes of it, it is plain, that he did not so much as dream of any great share it had in that action, as appears from his own words *De Corde*, p. 75. — ' But, says he, (to observe this by the bye) seeing the motion of the heart is perform'd by contraction, and that its fibres are designed for constriction only; it also appears, that it wholly consists in the *Systole*; and therefore, as soon as that force is taken off, whereby these fibres are over-strained in every constriction, the heart is again relaxed, as it were, by a motion of restitution, and distended by the influx of the blood into its veins; for the *Diastole* succeeding by equal intervals, and with an equal force can be owing to no motion of the heart, but what either

' slack-

' slackens its tension, or from the influx of the blood?' But, if contraction be the sole action of these fibres (as Dr. *Lower* confesses) and as indeed, it is of all muscular fibres, how came he to fall into such an absurdity, as to call their distension (vulgarly, but improperly called their relaxation) a motion of restitution? For, from the nature of those fibres, and their disposition in the structure of the heart, the natural state thereof appears plainly to be tonical, and its dilatation a state of violence; and consequently, the constriction is the true motion of restitution, and the state to which it will spontaneously return, when the force is taken off, which is the office of the intercostal muscles and diaphragm: Thus, we are still left to seek for the true cause of the *Diastole*, which seems to Dr. *Drake* to be the main, and most difficult phenomenon relating to the heart, and the circulation of the blood: But Mr. *Cowper*, in his *Anatomy of Human Bodies*, has further prosecuted and improved, the share, Dr. *Lower* hints, the blood has in that action, so as to make it the main instrument of the dilatation of the heart, wherein Dr. *Drake* agrees entirely with him; tho' he cannot be so entirely of the same opinion as to the manner, and reasons of its being so very instrumental; ' The heart, says Mr. *Cowper*, of ' an animal, bears a great analogy to the pendulums of artificial ' *Automata*, as clocks and watches, whilst its motion is per- ' form'd like that of other muscles, the blood doing the office of ' a *Pondus*:' By the blood doing the office of a *Pondus*, Dr. *Drake* supposes, that Mr. *Cowper* means, the blood contributes in the same manner to the motion of the heart, as the weights do to that of the pendulum of a clock; if so, the blood, according to him, must be the instrument of constriction; and dilatation must be the natural state, or the spontaneous motion, to which it would, when under no violence return; the contrary of which will hereafter appear: But, if he means, that the blood in its reflux, by gravitating on the auricles and ventricles, dilates and expands them, acting therein, as a counterpoise to its contraction as a muscle; Dr. *Drake* could wish, Mr. *Cowper* had not confined himself to so narrow a compass, but had given us an explication at large of so abstruse, and so important a phenomenon; because, the specific gravity of the blood seems to Dr. *Drake* a cause by no means alone adequate to the effect, which it is here supposed to produce; for, if the blood acts only as a weight by mere gravitation, then that portion of it only, which descends from the parts above the heart, can be employed in that action; this, at the largest computation, cannot amount to 5 pounds weight,

weight, and must, according to *Borelli's* computation, move a machine, that is able to overcome a resistance of 135,000 pounds; and after making a reasonable deduction, the Dr. is satisfied, that it is not to be effected in the least by so small a weight; but neither does the reflux blood gravitate in any such proportion, as the Dr. has here assigned; for, to make a true estimate of its gravitation, we must consider the circumstances of the liquor supposed to gravitate; in which, it very much resembles water inclosed in a re-curve tube; which, if the length of both its legs be equal when full of water, it may be suspended in the air, with its extremities downwards, without losing a drop, tho' the diameter of those legs should be very unequal; the case of the arteries and veins is pretty nearly similar to a tube so filled and inverted; for, if the arteries and veins be continued tubes, (as they appear by a microscope) then supposing their contents to have no other determination of motion, than their own weight would give them, the contained fluids must be counterpoised to each other; for, the veins and arteries being joined at the smaller extremities, and the larger of either terminating in the same parallel line, it is impossible, according to the laws of hydrostatics, that the contents of one should over-balance the other; how far then, must it fall short of forcing the natural power and resistance of so strong a muscle as the heart, by mere gravitation; the blood indeed, has a progressive motion thro' its vessels, wherein it differs from water in a re-curve tube, in the experiment above-stated; but, if the natural gravitation of the blood contributes nothing to the dilatation of the heart, this progressive motion will be found more insufficient; for, as this motion is entirely derived from the constriction of the heart (as all accounts hitherto derive it) could the blood be supposed to re-act upon the heart, with all the force impressed upon it at first by the heart, it would be insufficient; unless we suppose the force communicated to be superior to the power communicant, which is absurd; but when the just and necessary deductions for the impediments, which the blood meets with in its progress thro' the vessels, shall be made, the remaining force will be found so exceeding weak, that to force the blood thro' the veins may alone be a task too great for so small a power, without charging it with the additional difficulty of forcing the muscles of the heart: *Borelli* calculates the force of the heart and the muscular coat of the arteries, to be together equal to a weight of 3750 pounds, and he allots them a resistance equal to 180,000 pounds, to overcome which, is as 45 to 1; and to make up for a disproportion, he

he flings into the scale the additional force of percussion, which he leaves indefinite, and thinks sufficient to force any quiescent finite resistance whatsoever; supposing then the force of the heart, and of the muscular coat of the arteries, as likewise of the resistance, which they must overcome, to be computed with any degree of accuracy, there still remains such a prodigious disproportion to be accounted for, as requires some more powerful agent, than any yet assigned, to make up the deficiency: What assistance the heart receives from the action of the *Thorax*, towards facilitating its contraction, without which there could have been no *Systole*, has been already shewn; but, neither the intercostal muscles or diaphragm, which are so instrumental in that part of its action, can contribute any thing to the *Diastrale*; because, they serve only to enlarge the cavity of the *Thorax*, and thereby open a passage to the blood from the heart, and promote its constriction: Whatever, therefore, the force is, that dilates the heart, and is the cause of the *Diastrale*, it must be equal to that of the heart, the intercostal muscles, and diaphragm, to all which it acts as an antagonist; without taking into the account the *Serratus major anticus*, and other muscles, which have an obscure share in the elevation of the *Costæ*; because so much may reasonably be deducted on account of the *obliquus externus Abdominis*, and other muscles, which, having their insertions on some of the lower ribs, are as instrumental towards their depression, and so ballance the account; but the chief use of these is in violent respiration; their share, in ordinary respiration, being but small: Such a real power (which may in the least be suspected of any share in this action) is difficult, perhaps, impossible to be found in the machine of any animal body; and yet, without some such antagonist, it is as impossible the circulation of the blood should be carried on; all the engines, hitherto discovered within the body, conspire towards the constriction of the heart, which is the state of quiescence, to which it naturally tends; yet, we find it alternately in a state of violence, that is, of dilatation; and this must necessarily be so, because, upon this alternation depends all animal life; some sufficient external cause must therefore be found out, to produce this great phenomenon; which cause, must be either in the air, or atmosphere, because we have no constant and immediate commerce with any other mediums: Some great physicians, observing this, and that upon being deprived of communication with the external air, we became instantly

extinct, have imagin'd, that in the act of inspiration, certain purer particles of the air are mix'd with the blood in the lungs, and conveyed with it to the heart; where it nourish'd a sort of vital flame, which was the cause of this reciprocal *Æstus* of the heart; others not quite so gross, rejecting an actual flame, have fancied, that these fine particles of air, mixing with the blood in the ventricles of the heart, produced an effervescence, which dilated it; but these fancies have been long since exploded; and it is a point still undetermin'd, whether or not any air at all mixes with the blood in the lungs.

But supposing, that some air may insinuate itself into the pulmonary vein, it can no otherwise dilate the heart, than by an effervescence in the left ventricle, which would not dilate the right; but this opinion is contradicted by *Autopsie*, and laboriously confuted by others; there remains therefore, only the gross body of the atmosphere to be consider'd, which is undoubtedly, the antagonist to all these muscles, which serve for ordinary inspiration, and the constriction of the heart; this will appear more evidently, if we consider not only the power, but the necessity of its action upon animal bodies, as well as the want of other sufficient agents.

The heart is a solitary muscle of very great strength, and the intercostal muscles, and diaphragm, which likewise have no antagonists, are a vast additional force, which must be balanc'd by the contrary action of some equivalent power, or other; for tho' the action of the intercostal muscles be voluntary, that does not exempt them from the condition of all other muscles serving for voluntary motion, which would be in a state of perpetual contraction, notwithstanding any influence of the will, were it not for the libration of antagonist muscles; this libration between other muscles is answered by the weight of the incumbent atmosphere, which presses upon the *Thorax*, and other parts of the body; and, as in all other voluntary motions, the influence of the will only gives a prevalence to one of two powers, before equi-librated; so here it serves to enable those muscles to lift up a weight too ponderous for their strength, not so assisted; and therefore, as soon as that assistance is withdrawn, the *Costæ* are again depress'd by the mere gravitation of the atmosphere, which would otherwise remain elevated, thro' the natural tendency of those muscles to contraction: This is plainly prov'd from the *Torricellian* experiments, and those made upon animals in Mr. Boyle's engine;

gine; where, as soon as the air is withdrawn, and the pressure thereby taken off, the intercostal muscles, and diaphragm are contracted, and the ribs elevated in an instant, and cannot by any power of the will be made to subside, till the air is again admitted to bear them forcibly down.

Dr. *Willis* having observ'd, that the fibres of the external and internal intercostal muscles ran in a contrary order, as it were, decussating each other, takes occasion from thence to fancy, that there was an opposition in their office; and that as the external serve to raise up the ribs, the internal drew them down again; not considering, that when a contractible body is fasten'd at its several ends to points unequally movable, let the contraction happen in what part, or manner soever, the more movable point must be drawn towards that, which is less movable; by which rule whether the external or internal intercostals are contracted, the lower ribs will be forc'd to approach the upper, that is be elevated: As in the elevation of the *Costæ*, the blood by the passage that is open'd for it, is in a manner solicited into the lungs; so in their depression, by the subsidence of the lungs, and the contraction of the blood vessels, both which are consequent thereto, the blood is forcibly driven, as it were with an *Embolus*, thro' the pulmonary vein into the left ventricle of the heart; and this, together with the general compression of the body, by the weight of the atmosphere, which surrounds and presses upon its whole surface, is that power which causes the blood to ascend, in the veins, after that the force impress'd thereon by the heart is broken and spent; and which is sufficient to force the heart from its natural state to a dilatation.

He that can compute the weight of a column of air, equal to the surface of the whole body, will readily grant it a power sufficient for the effects, here ascribed to it; and when he considers, that the bodies of animals are compressible machines, he will find, that it must necessarily affect them, in the manner here laid down; but tho' our bodies be entirely compos'd of *Tubuli*, or vessels fill'd with fluids, yet this pressure how great soever, being equal, could have no effect upon them, if the superficial dimensions were not easily variable; because, being compressed on all parts, with the same degree of force, the contain'd fluids could not any where begin to recede, and make way for the rest to follow, but would remain as fix'd and immovable, as if they were actually solid; but by the dilatation of the *Thorax*, room is made for the fluids to move, and

by its co-actation fresh motion is impress'd, which is the main spring, whereby the circulation is set, and kept going: This reciprocal dilatation, and contraction of the superficial dimensions of the body seems so necessary to animal life, that there is not any animal so imperfect as to want it, at least, so far as our anatomical discoveries have yet reach'd; for tho' most kinds of fish, and insects, want both movable ribs, and lungs, and consequently have no dilatable *Thorax*; yet that want is made up to them by an analogous mechanism, sufficiently answering the necessities of life; those fishes, which have no lungs, have gills, which perform the office of lungs, receiving and expelling alternately the water, whereby the blood-vessels suffer the same alteration of dimensions, that they do in the lungs of more perfect animals; the lungs or air-vessels of insects are still exceedingly more different in structure, distribution, and situation from those of perfect animals, than those of fishes are; and yet in their use, and action perfectly agree with both, that is receiving, and expelling the air, and varying the dimensions, and capacities of the blood-vessels; these having no *Thorax*, or separate cavity for the heart, and air-vessels, have the latter distributed through the whole trunk of their bodies, by which they communicate with the external air thro' several *Spiracula*, or vent-holes, to which are fasten'd so many little *Tracheæ*, or wind-pipes, which thence send their branches to all the muscles, and *Viscera*, and seem to accompany the blood-vessels all over the body, as they do in the lungs only of perfect animals; by this disposition, in every inspiration, the whole body of these little animals is inflated, and in every expiration compress'd; and consequently, the blood-vessels must suffer a vicissitude of extension, and contraction, and a greater motion must thereby be impress'd upon the fluids contain'd in them, than the heart, (which does not in these animals appear to be muscular) seems capable of giving: The only animal that is exempted from this necessary condition of breathing, or receiving, and expelling alternately some fluid into, and out of the body, is a *Fœtus*; but this, while included in the womb, has little more than a vegetative life, and ought scarcely to be reckon'd amongst the number of animals; for were it not for that small share of muscular motion, which it exercises in the womb, it might without any absurdity be accounted as a graft upon, or a branch of the mother.

Concerning the immediate matter, and means of life, and nutrition, authors are not agreed; nor is it the business of this place to reconcile, or decide their differences, but to account for the motion of the blood thro' the vessels only: In order to this it will be necessary to observe, that the pulsation of the heart in a *Fœtus* is so very weak and obscure, and the motion of the blood so extremely slow and languid, as to be scarcely, if at all, perceivable; as has been experienc'd in the dissection of puppies before respiration; to produce such a feeble palpitation, and creeping motion, no greater force seems to be requir'd, than may be deriv'd from the communication between the vessels of the mother, and *Fœtus* in the *Placenta*: Such as reject this communication, usually do it in favour of one, or both of these opinions; viz. that the arteries of the *Uterus* deposite a nutritive juice, or a juice impregnated with air in the *Placenta*, which is suck'd in by the umbilical vein and conveyed to the *Fœtus*, for the necessary uses of nutrition and life; now they who patronize either of those opinions lead nature an unnecessary dance; for if the maternal blood does really contain any such nutritious, or any such necessary aerial particles, why should they be separated, and extravasated, to be with difficulty received into the umbilical vein, and again mix'd with the blood, when they might be more easily imparted by the plain simple way of transfusion, from the arteries of the mother to the veins of the *Fœtus*; and that this is the course, which nature takes in this case, Dr. Drake is persuaded from the easiness, and simplicity of the method: They who contend for the conveyance of a nutritious juice, thro' the umbilical vein from the *Placenta*, run into two difficulties, which are next to absurdities; for first, they are oblig'd to make this vein, which like all other veins, seems design'd for the re-conveyance of blood only, the proper and immediate channel, thro' which a very different liquor is to be conveyed; and in the next place, to give a power of attraction, or suction thereto; because the nutritious juice, which it is thus destin'd to convey, is both viscous, and stagnant; and has neither force to propel, nor subtilty to penetrate, or insinuate itself into the capillary veins; and therefore must be drawn, or suck'd, as milk is from the breast; to which the *Placenta*, and its nutritious juice are, by the favourers of these opinions, expressly compar'd; but if this were the sole use of the *Placenta*, and umbilical vessels, why were the umbilical arteries sent along with the vein? Their office is not to bring any thing back to
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the *Fœtus*, nor can they contribute any thing to the benefit of the mother; for the uterine arteries convey all to the *Placenta*; the umbilical vein to the *Fœtus*, and the uterine veins return again the sur-charge of the mother's blood; the umbilical arteries alone, have nothing to do, and are superfluous, which is contrary to the constant practice of nature; yet if *Autopsie* did, in the least countenance this hypothesis, some defence might still be made; but we find in the umbilical vein of a *Fœtus* nothing but florid blood, such as in all probability it receiv'd immediately from the arteries of the mother, without any mixture.

Such as supply the body of the *Fœtus* with air from the *Placenta*, are as much distress'd as the former; for they are oblig'd to beg the question twice, which even when granted, will not answer their ends; first they suppose, that an intimate mixture, and confusion of air with the blood, is necessary for the support of animal life, a *Postulatum*, which perhaps the former part of this discourse might have render'd unnecessary; and next that the *Fœtus* is supplied with air from, and its blood mixt with it in the *Placenta*; and here again they fetch a compass without necessity, or proof; for if a mixture of air were necessary to a *Fœtus*, why should it be separated from the mother's blood, and not rather communicated both together, since it is so much more easy and commodious; but neither does the *Placenta* seem to be provided for the separation of air, but of a much grosser fluid, destin'd to some other use, which *Autopsie* confirms; yet were both these opinions true, they are however defective, and the circular motion of the blood unprovided for: By transfusion this great phenomenon is naturally accounted for, and the ends, for which the other two hypotheses were devis'd, might both be answer'd with more ease; for the hysteric arteries, transmitting their blood immediately to the umbilical vein, may very easily transmit such nutritious juices, or aerial particles as are contain'd in the blood, along with it, without depositing them by the way; by this means, so much of the impulse of the mother's blood is preserv'd, as suffices to maintain that languid circulation, which a *Fœtus* has; for the blood being propell'd thro' the arteries of the *Uterus* into the umbilical vein, is directly conveyed to the *Sinus* of the *Porta*; and thence by a short and direct passage thro' the *Cava* to the heart; where passing thro' the *Foramen ovale* to the left ventricle, and thro' the *Canalis arteriosus* from the right, and pulmonary artery,

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it is all deliver'd, without coming at the lungs, to the *Aorta*, and from thence again by the umbilical arteries to the veins of the *Uterus*, making a sort of epicycle to the main circulation in the mother.

As this opinion is favour'd by the structure and disposition of the blood-vessels on both parts; so there is nothing in it difficult to be conceiv'd, or repugnant to experience; later discoveries have made it apparent, that the arteries and veins are continu'd tubes; and that the latter contain nothing but what they receive from the former; and there appears no reason, why we should suppose this method to be varied in the *Placenta*; on the other hand, if the arteries of the *Uterus* were continu'd to the veins of the same part, and those of the *Fœtus* in like manner without communicating with each other, their confluence in the *Placenta* seems to be altogether useless; and the umbilical arteries and veins fram'd for no other service, or purpose, than to give the blood room for an idle fally: Mr. *Cowper* has re-establish'd this old, but long exploded truth; for by pouring mercury into a branch of the uterine artery of a cow, that went into one of the *Coryledons* of the *Uterus*, he fill'd those branches of the umbilical veins, which went from that *Coryledon* to the navel of the *Fœtus*: Now it would be a weak objection to alledge that the observation, and experiment having been made on the *Uterus* of a cow, the inference would not hold from thence to a woman, the one being glanduliferous, and the other placentiferous; since every one of these *Coryledons*, or uterine glands, is in all respects a little *Placenta*, and all the difference between them is in number, name, and magnitude; why ruminants differ in this particular, from other viviparous animals, is beside the subject of the present enquiry; but the great flux of blood which constantly follows upon extracting the *Placenta* from women (which is frequently so great, as to cost them their lives) is as plain a demonstration to reason of the continuity of the vessels, as Mr. *Cowper*'s experiment is to the eye.

It is objected by some, that if there was such a continuity of vessels, and such a transfusion of blood, the *Fœtus* must necessarily perish thro' loss of blood, upon the separation of the *Placenta* from the *Uterus*; but that on the contrary, no visible flux of blood ensues, while the *Fœtus* continues wrapt in the membrane, in which condition it may be kept alive some hours; to this it may be answer'd, that the circulation in the *Fœtus*, being deriv'd from the mother, may be suppos'd to cease

cease wholly upon cutting off the communication between them, till it is again more forcibly renew'd by respiration : But if we allow that the motion already impress'd upon the blood is sufficient to keep it going a little while, yet it must be so exceeding languid, that the mere resistance of the external air must be more than enough to hinder any efflux of blood from a *Fœtus* before respiration ; how long life may be preserv'd, without an actual circulation of the blood, is a question not to be discuss'd at present ; but we may be convinc'd by several observations and experiments, that life has been recover'd a long time after all signs of respiration, circulation, or even life itself, have disappear'd ; so that we cannot think the first solution either impossible, or improbable ; it may be further objected, that in the early days of gestation in viviparous animals, there is no *Placenta*, nor any adhesion of the umbilical vessels to any part of the *Matrix*, and consequently no such transfusion ; and that in oviparous animals there is no continuity, or communication of vessels of any kind, during all the time of incubation ; but these objections carry neither the weight, nor difficulty along with them that they may be suppos'd to do ; for in those days there is neither blood nor blood-vessels, and consequently there can be no circulation of the blood ; and the embryo, of what species soever, is no more than a vegetable at that time ; nor does the *Fœtus* of any viviparous animal enjoy any circulation, or shew any signs of animal life, till after those vessels, as well as others, requisite to the circulation, are compleated : It must be confess'd, that oviparous animals are denied the benefit of this communication ; but that deficiency is sufficiently compensated by a peculiar mechanism, which directly answers the end of respiration, and the pressure of the atmosphere upon the *Fœtus* ; there is at the obtuse extremity of an egg a small cavity, fill'd with air, which is the succedaneous instrument to the respiratory organs ; for as soon as the contents begin to be warm'd by the incubation of the hen, or any analogous heat of furnace or dunghill, the several humours of the egg acquire a fermentative motion ; and the air contain'd in the cavity, or vesicle at the obtuse extremity of the egg is rarified, and the vesicle itself extended and enlarged ; and consequently, the other contents are compress'd, to which the fermentative motion naturally resists ; but both bodies being as well compressible as dilatable, and both having an expansive motion impress'd upon them by incubation, the compression and renitency will

will be mutual, but varied in degree; according as either, by the variation of circumstances, shall prevail; by this means, an alteration of compression and dilatation will be produced in both, answering the respiratory motion; by which a motion will be communicated, which, as soon as the organs, by which it should be regulated, are compleated, will in the body of the *Pullus*, or chick, be regular and circulatory.

Fabritius ab Aquapendente, and after him *Dr. Harvey* have assigned divers uses to this cavity, or air-vesicle; but, tho' *Dr. Drake* cannot agree to that perspiration, refrigeration, and respiration, which they make it the instrument of; yet, perhaps, the air, that was inclosed in that cavity, may, thro' the increase of the body of the *Pullus*, and its own rarefaction (which is, at last so great, as to occupy half the shell) break the membrane, which separated it from the *Pullus*, and thereby give it so much respiration, as to form the chirping, which is often heard before the breaking of the shell; and therewith give it an addition of strength to enable it to break the shell; but, how it should respire sooner, the *Dr.* cannot conceive: There are several problems of great seeming difficulty, the solutions of which flow naturally from what has been here laid down; the *Dr.* therefore attempts the *Harveyan* problem; viz. *Why a Fœtus taken out of the Uterus with its membranes entire, shall live in water some hours without communication with the external air; whereas, if it be taken out, and suffer'd once to breathe, it cannot afterwards survive a moment, without the benefit of respiration?* Granting the fact to be as *Dr. Harvey* has delivered it, which yet is not so in all cases, the main difficulty is grounded on a mistake, which from the stating of the question this great man slipt into; for, he imagines, that a *Fœtus* is sooner suffocated, after having once breathed, than if it had not breathed at all; and that by breathing, it had contracted something, which rendered it more apt to perish; *Harv. de Gen. Anim. Cap. de Partu*: *Dr. Harvey* observing, that a *Fœtus* liv'd longer without respiration, and dispenc'd better with the want of air, while included in the entire membranes, than it could afterwards; infers from thence, that the air does, in the first act of inspiration, impress upon the lungs some quality, which renders it ever after more indispensably necessary; but allowing his observation, *Dr. Drake* denies his inference to be good; for, deprive a *Fœtus* of the means of respiration, and then take it out of its membranes, and it will be as soon suffocated as if it had respired before;

before; this proves, that this necessity of intercourse with the air, by the way of the lungs, is not the offspring, but the parent of respiration; and, that that learned man was drawn into a fallacy of *Non causa pro causa*: The reason of this necessity is the pressure of the external air upon the surface of the body, from which it was defended by the interposition of the membranes, and the humours contained therein, which are not so compressible, as the body of the *Fœtus* itself; therefore, as soon as the *Fœtus* is excluded, and exposed to the immediate contact of the circumambient atmosphere, the vessels, and all the cavities of the body must necessarily be so compressed, that the fluids cannot have room for motion; and consequently, the *Fœtus* could have no life, if nature had not contrived by the motion of the *Thorax*, to remove and admit that pressure alternately, and thereby impress a motion on the fluids, which is the spring of life; but, this motion of the *Thorax* being any way suppressed, the equal pressure of the atmosphere on all parts occasions a total cessation of motion, which is death.

A Pocket-Microscope; by Mr. Wilson. Phil. Trans. N° 281. p. 1241.

THE late improvements, made by magnifying glasses, are not so much owing to their make, and the compounding of microscopes, as to the methods of applying objects for the advantage of light; and experience, as well as the authority of Dr. Hook in his preface to his *Micrographia*, assure us, that single magnifying glasses, when they can be used, are preferable to microscopes, compounded of two or more magnifying glasses.

Mr. Wilson's sett of microscopes, has eight different magnifying glasses; seven of which may be used, with two different instruments, for the better applying them to various objects; one of these instruments is represented in Plate VI. Fig. 1. A A A A, and is made of ivory, it has three thin brass plates E E, and a spring of brass H within it; to one of the thin plates of brass is fixed a piece of cork F, with a concavity G both in the cork and brass, to which it is affixed; in one extremity of this instrument there is a long screw D, with a glass C screwed thereon; in the other extremity there is a hollow screw O O, wherein any of the magnifying glasses are screwed, when they are to be made use of; the eight different magnifying glasses are all set in ivory; seven of which are set in

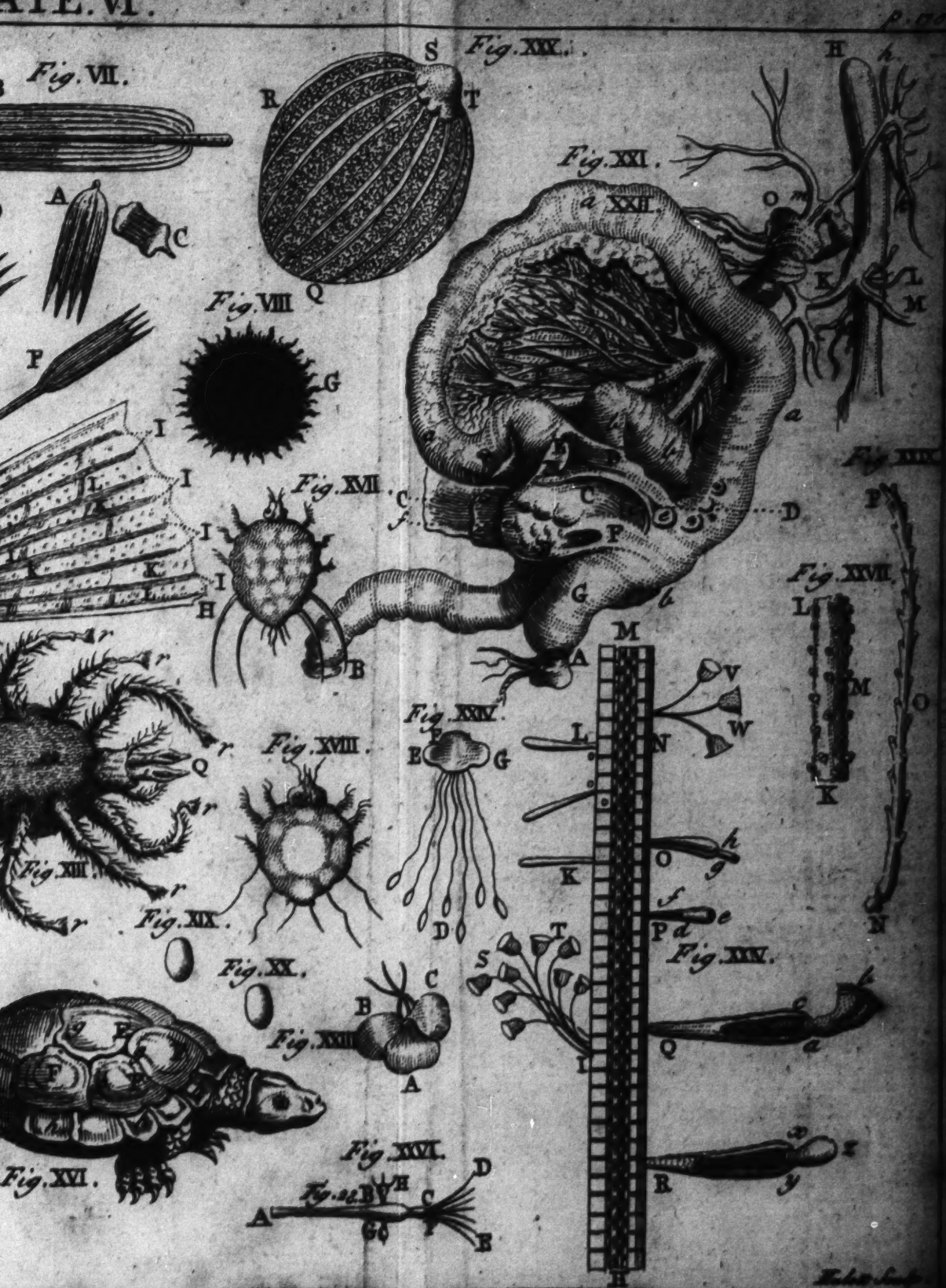
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in the manner of Fig. 2. N^o 4; the greatest magnifier is marked upon the ivory, wherein it is set with N^o 1, the next N^o 2, and so on to N^o 7; the eighth glass is not mark'd, but set in the manner of a little barrel-box of ivory, as in Fig. 3.

Fig. 4. *ee* is a flat piece of ivory, whereof there are several belonging to this set of microscopes, in each of which there are three holes *fff*, wherein three, or more objects are placed between two thin glasses, or talks, when it is to be used with the greatest magnifiers.

The instrument Fig. 5. is made of brass, or prince's metal, with joints P P P, to turn easily any way, with a small pair of tongs G G, which open at the points *k*, by pressing together the two heads of the pins I I for taking up of objects; there is a round piece of ivory H, screwed upon the other extremity of the tongs, white on one side for black and opaque objects, such as are seeds or sands; and black on the other side for white objects of that nature; upon the sharp point A of this brass instrument, all the eight glasses, as you see in Fig. 2. N^o 4, may be fixed; there being a hole in the ivory for that purpose, wherein the glasses are set, with a thin piece of brass B in the manner of a spring, to hold it the firmer; so, that when any object is taken up on the points of the tongs *k*, or laid upon the other extremity H, it may be very easily applied to the true distance of any of the glasses, by the help of the joints P P P P, as also the screw C, and wheel D, which will bring the object to the exactness of the centre or true distance, being regulated by a spring E.

The use of the first mentioned instrument Fig. 1. A A A A is thus; take one of the flat pieces of ivory, or registers, as they may be called, *ee* Fig. 4, and slide it in betwixt the two thin plates of brass E E, in the body of the microscope; so, that the object you intend to look upon, may be exactly in the middle, observing to put in that side of the plate *ee*, where the ring is farthest from your eye; then screw into o o, the 3d, 4th, 5th, 6th, and 7th magnifying glass; which being done, while you are looking thro' the magnifying glass upon the object, you are to screw in, or out, the long screw D in the other extremity of the body of the microscope, till you bring the object to the true distance, which you will find by seeing the object clearly and distinctly; but, since in the greater magnifiers, you can see but a small part of the objects, *viz.* the legs or claws of a flea; while you are looking upon any part of the object, if you take hold of the end of the plate *ee*,

whereon the object lies, and move it gently, you may see the whole object successively, or any part of the object you please; and if that part of the object, you design to look upon, be out of the true distance, your end screw D can always bring it in, by bringing it nearer, or farther off; after this manner, may be seen all transparent objects, dust, liquids, crystals of salts, small insects, such as fleas, mites, &c. If they be insects that will creep away, or such objects as a person intends to keep, they may be placed between the two register-glasses *ff*; for, by taking out with the point of a pen-knife the ring that keeps in the glasses *ff*, where the object lies, they will fall out of themselves; so, you may lay the object between their two hollow sides, and put the ring in, as before; but, if the objects are dust, or liquids, a small drop of the liquid, or a little of the dust laid on the outside of the glass *ff*, and applied as before, will be seen very easily; as to the 1st and 2d magnifying glasses, being mark'd with a cross upon the ivory, wherein they are set, they are only to be used with those register-plates, that are also mark'd with a cross, wherein the objects are placed between two thin talks; because, the thickness of the glasses in the other registers, or plates, hinders the object from approaching to the centre, or true distance of these great magnifiers; but the manner of using them is the same with the former; only remember, when you put in, or pull out the same plate or register *ee*, whereon the object lies, or move it from one object to another, not to let it rub upon your magnifying glass, which is done by opening a little the screw D, when you put in, or take out the plate, or move it from one object to another: For viewing the circulation of the blood at the extremities of the arteries and veins, in the transparent parts of fishes, eels, &c. there are two glass tubes, the one bigger, and the other smaller, as Fig. 6, wherein the fish is to be put; when this lesser tube is used, you are to unscrew the end-screw D in the body of the microscope, till the tube *gg* can easily enter into that little cavity G of the brass plate fastened to the cork F, under the other two thin plates of brass E E; when the tail of the fish lies flat to the glass-tube, set it opposite to your magnifying glass; and by screwing in, or out, the end-screw D, you may easily bring it to the true distance, and see the blood circulate; when the larger tube is to be used with a larger fish, or frog; then you are to take out the brass plate G F fastened to the cork, by pressing down the other two plates E E, and the spring H, to the

the end of the microscope B; and by turning the cork and brass-plate GF sideways, you may easily take it out, and put it in again; when the cork-plate GF is out, the larger tube will easily enter into the body of the instrument, and is to be used in the same manner with the smaller tube. If you would see the circulation of the blood in a frog's foot, chuse such a one as will just go into your tube, then with a little stick, expand its hinder foot, and apply it close to the side of the tube, observing, that no part of the frog hinder the light from falling on its foot, and when you have it at the exact distance, by means of the screw D, you will see the rapid motion of the blood in its vessels, which are very numerous, in the transparent thin membrane that is between the frog's toes; for this object the third and fourth magnifiers will do very well; but you may see the circulation in the tails of water-newts with the fifth and sixth glass, because the globules of blood in these newts, are as big again as those of the blood of frogs or small fish, as Mr. *Cowper* has observed Phil. Trans. N^o 280: Observe, that the circulation cannot be so well seen by the first and second magnifiers, because the thickness of the glass, wherein the fish lies, hinders the approximation.

The glass placed in the manner of a barrel box Fig. 3. is only to be used with the brass-instrument, or in the hand, being the least magnifier for larger objects, such as flies and common insects, &c. the hole *a* in the side of this box is to be fix'd on the point A of the brass-instrument, observing to put the extremity *b* next your eye and the other to the object; for if you take up any insect on the point of the tongs *k*, or lay any opaque object on C the other extremity, you may bring them to the true distance by the help of the screw, spring and joints C D P E: In viewing of objects, especially such as are opaque, you must take care not to hinder the light from falling upon them; for nothing can be seen with the best of glasses, unless the object be at a due distance, and in a sufficient light; the best light for the plates, or registers, where the object lies between the two glasses, is a clear sky-light, or where the sun shines upon any white object, or the reflection of the light from a looking-glass; the light of a candle is likewise good for observing the circulation in very small objects, tho' it be a little uneasy to such as are not conversant in microscopes, to find out that light: For the conveniency of drawing sketches, or designs after microscopical objects, Mr. *Wilson* has made a pedestal to fix the two instruments above described upon, and make them stationary to any convenient light; this

this pedestal may be placed upon a table, &c. and after that the object and light are fix'd, the object may be seen without any trouble or difficulty in finding the light.

Fig. 7. A B C D E F represent the feathers of the wings of butter-flies and moths; A B, are the same, only differently magnified; A as it appeared by the fourth glass, and B by the first; C D E F were all view'd by the fourth glass and were taken from different parts of those insects.

G Fig. 8. is a grain of the *Farina* of the capilaments of mallows viewed by the first glass.

H H Fig. 9. is the tail of a small fish, view'd when alive by the fourth glass; *ii* is that part of the tail next the body of the fish, where the trunks of the veins and arteries pass together; *IIII* their extremities which appear united; *k k k* other inosculation, with the arteries and veins appearing in the transparent membrane, between the cartilages K K; L L L, L are the cartilages compos'd of several joints, on each side of which, the trunk of a vein and artery passes.

M Fig. 10. an *Animalculum*, whereof a great number appeared moving up and down on the tail of the fish.

N Fig. 11. represents a side-view of the same *Animalculum*.

O Fig. 12. is another *Animalculum* of a different figure from the former, that stuck to the tail of the fish by its jagged extremity, and frequently drew in and out its long body.

P Q Fig. 13. represents one of the lice found on the beetle, called *Scarabeus Pediculofus*, view'd by the fourth glass; P its *Anus*; Q its two claws, not unlike those of a lobster; *rrrr* the extremities of its feet, which have a remarkable contrivance for sticking fast on the smooth surface of the beetle; not in the manner of claws, as several other insects, but divided into capilaments, as represented in the figure.

S Fig. 14. the same animal as it appear'd to the naked eye.

A Water-spout at Hatfield in Yorkshire; by Mr. Abraham de la Pryme. Phil. Transl. N° 281. p. 1248.

ON the 15th of *August* 1687, about two o'clock in the afternoon, there appear'd a water-spout in the air at *Hatfield* in *Yorkshire*; it was about a mile off, coming directly towards the place where Mr. *de la Pryme* was; the season was very dry, the weather extremely hot, the air very cloudy, the wind a-loft and pretty strong; and what was remarkable was, that it blew out of several quarters at the same time, and fill'd the air thereabouts with very thick black clouds, in different layers; this blowing
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of the wind soon caus'd a great vortex, gyration and whirling among the clouds, the center of which, every now and then dropt down, in the shape of a thick long black tube, commonly call'd a spout; in which Mr. *de la Pryme* could plainly see a motion like that of a screw, continually drawing and screwing upwards, as it were whatever it touch'd; in its progress it moved slowly over a hedge-row and grove of young trees, which it caus'd to bend, like hasel-wands, with a circular motion; then advancing forwards to a large barn, it twitch'd off in a minute all the thatch, and filled the whole air therewith; and coming to a very large oak, it made it bend like the aforesaid trees, and broke off one of the largest and strongest branches, and twisting it about, flung it to a very considerable distance off; then coming within 300 yards of him, Mr. *de la Pryme* beheld this extraordinary phenomenon, and found that it proceeded from a gyration of the clouds, by the meeting of contrary winds in a point or center; and where the greatest condensation and gravitation was, falling down into a large pipe or tube, something like the *Cochlea Archimedis*; and in its whirling motion, it either sucks up water, or destroys ships, &c. having gone about a quarter of a mile farther, it was dissolved by the prevalency of the wind, which was easterly.

The Mischief occasioned by swallowing Fruit-stones, &c. by Mr. Vaughan. Phil. Trans. N^o 281. p. 1244.

A Gentleman had eat above two pounds of common prunes, and some time after, about a pound more; a fortnight before he died he had some symptoms of the stone; he had a violent pain in the neck of the *Vesica*, and about the *Urethra*, with obstructions in his urine, &c. Mr. *Vaughan* ordered him a terebinthinate glyster, which gave him ease; his pains afterwards increasing, a physician was sent for, who prescribed glysters, with diuretics and narcotics, to no purpose; after his death he was dissected in presence of Dr. *West*, and others; when it was found that the prune-stones had made a perforation thro' the *Intestinum Rectum* into the *Pelvis*; upon tying a part of the gut, and cutting out a piece, and emptying it, there was taken out 128 prune stones, besides what were left behind in *Stercore*, in the other part of the *Intestinum Rectum*: There was also a large *Polypus* taken out of the left ventricle of the heart.

Mr. *Vaughan* attended a young man (14 years of age, of a sanguine complexion) for about 30 hours in an *Iliac* passion, which was very violent for the time; about 3 or 4 hours before he

he died, Mr. *Vaughan* administred a terebinthinate glyster, which gave, during its stay, immediate ease; he continued so for about an hour, when his disease returned again as severe as ever; some time before he died he voided some of his glyster by vomit; after he was dead, Mr. *Vaughan* dissected his body, and he found the liver only something bigger than ordinary; the stomach was considerably distended, and the *Fæces* had made a breach thro' the *Jejunum*, some of which was evacuated; a considerable portion of the *Ilium* was very livid, but not in the least distended; the *Colon* very much resembled a contus'd wound about 3 or 4 days old; in the centre he found it fresher, and not so livid as the outside; about the origin of the *Rectum* there was another large rupture, at which more *Fæces* were voided.

Mr. *Vaughan* had also dissected an emaciated person that had died of a dropsy, out of whose body he tapped 10 gallons of water: He also dissected a child, which had an involution of the intestines, popularly call'd the twisting of the guts.

Some Observations on Coral, large Oysters, &c. in Ceylan; by Mr. Strachan. Phil. Transf. N° 282. p. 1248.

TH E R E is a great quantity of white coral upon the shore between *Gale* and *Mature*, and several other coasts in the *Indies*, which the *Dutch* burn to make lime for building of houses and their fortifications; there are large banks of this coral; it is porous, neither so firm or smooth as the upright, which grows in small branches; and when they arrive to the full growth, there grow others betwixt them, and then upon these others come up, till it is become as thick as a rock; these branches are not softer when they are young than when they are ripe; yet Mr. *Strachan* always observ'd a slime upon them, which he supposed to be the substance that petrifies.

About 3 leagues from *Batavia* Mr. *Strachan* had seen oysters a foot in diameter; one of the shells of which grew till it was 3 foot broad and a foot thick; after the fish was putrified, he always observed a slime upon these shells, which lay only 3 or 4 foot under water: Upon the coast betwixt *Gale* and *Gindere* lies *Os Sepiæ*; and in the river at *Catoene* there are found rubies; and if a person searches among the sand in the water, he shall find above a drop weight of them in an hours time; but they are very small, and 20 of them will scarcely weigh a grain: Upon the sea coast there lie on the sands a kind of small cockles, as big as *oculi cancerorum*, or crabs-eyes, which have no cavity; and when they are pounded, they have the same effect with the testa-

testaceous powders, and are used instead of crabs-eyes: Here are several trees, some of which are above 6 fathoms high; whose roots grow, as it were, above ground in the following manner; when the twig is about half a foot high, there grows out of the middle of the stem, a little knot inclining downwards, that makes an angle with the stem of 30 degrees or thereabouts, till it touches the ground; where it fixes, emitting small sprigs, which before it touch'd the ground had neither branches nor leaves, but was all over green like a shoot; whilst this shoot grows, and the stem becomes higher, it still sends forth other sprigs, which always proceed from the middle of the trunk of the tree; thus it continues shooting forth, till the tree arrives at its full growth; and the higher the tree grows, the knots and shoots are the thicker, and the longer; so that one of the shoots which grows last, will be a foot thick in diameter, and 3 fathoms long: The flower call'd *Happumal*, is found upon a tree that grows in the same manner, only two fathoms high; if planted round an orchard they make an excellent hedge; for the leaves are thorny and prickly; when the flower decays it bears a fruit like a pineapple, but it is of no use: Some naturalists affirm that all plants have a heart, or something analogous thereto; it would be worth enquiring in what part the heart of these kinds of trees lies, as also that of the *Palmito* and *Cocoa*-tree.

It is hard to tell which of these two divinities; viz. the *Budun* and *Sakradewendra*, have the greater veneration paid them; *Sakradewendra* commands and governs all the rest of the Gods; and formerly he heard, they say, the prayers offer'd up to him from distressed people here upon earth, and granted their requests; but now the golden chair whereon he us'd to sit is gone; and the prayers now offered up to him have no efficacy, because the foot of that chair was made of a sort of wax, which would turn soft by the prayers and tears of the suppliants, and so sink downwards; by which means the *Sakradewendra* would look down and hearken to the prayer of the suppliant and grant his request; this chair, which was of fine gold, was distributed amongst the poor, which is the reason he does not now perceive, nor know when any one makes supplication to him; therefore, there are but few people that reap any benefit from the prayers and tears they offer to him; he can see a great way when he turns his eyes towards any place; for his forehead, the natives say, resembles a peacock's tail, full of eyes; and so sometimes it happens that he looks down and takes notice of men; but this is but seldom; therefore there is a necessity, say they, for one to

pacify these wicked spirits which trouble us here upon earth: Mr. *Sirachan* could not learn how long this *Sakradewendra* had been a deity, nor how long he would reign; for none trouble their heads with him any more.

The *Budun*, of whom their *Banapors* (or bibles if they may be so call'd) make great mention, has been transmigrated into all the species of animals in the world; first into an insect, and after his death his soul was regenerated into a mouse, afterwards into an ox, then a monkey, and so forth, till he became a man; and by his good life and merits was still promoted to a better state, till at length he became supreme of all the Gods: There have been three *Buduns*; every one of whose reigns has been computed in this manner; there is a great hill about half a mile, of perpendicular height, and about six miles in circumference, from which a bird once in 1000 years takes one grain of sand to a certain place, and every thousandth year it continues so to do, till it has removed all the hill.

Concerning the Ancient Greek and Roman Lyre; and an Explanation of an obscure Passage in one of Horace's Odes; by Dr. Molyneux. Phil. Trans. N^o 282. p. 1267.

IN the third ode of the fourth book of *Horace*, which begins; *Quem tu Melpomene, &c.* (esteem'd by the most learned critics both of the past and present age, one of the most correct master-pieces in its kind antiquity has left us) there is one of the most beautiful passages and surprising fancies of the ode, and which seems to have been overlook'd by all the critics and commentators;

*O testudinis aureæ
Dulcem quæ strepitum, Pieri, temperas?
O mutis quoque piscibus
Donatura Cygni, si libeat, sonum?*

When Dr. *Molyneux* first reflected on these lines, and observ'd *Horace's* great heat and vehemency in his repeated exclamations, on the power of his muse; as that she could give, when she pleas'd, even to mute fishes, the melodious voice of the swan; he look'd upon the fancy as entirely forced, and founded on nothing that was real or true in nature; and consequently, it could pass for no more than a wild rant, or extravagant whim of the poet's; yet, not being able to reconcile this with *Horace's* character, as a great master and judge in the art of poetry, and par-

particularly remarkable for his propriety of thought and delicacy of expression; upon second consideration he was convinced that this was the meaning of the passage, viz. that after he had, in the foregoing verses, acknowledged how much he was indebted to the bounty of his muse, he here makes a sudden exclamation to extol her great art and mystery, who by mixing various notes, could compose such sweet harmony upon the gilded lyre or *Testudo*, and by her surprising power could when she pleas'd, give even to mute fishes, or the hollow shells of the *Testudines aquaticæ*, or water-tortoises (a sort of fish, of whose shells the Dr. supposes they made their lyres in ancient times) the sweet melody of the swan; as for the comparison he makes to the voice of a dying swan, tho' that be a fiction, yet a vulgar error universally embraced, was ever sufficient authority for either a poet or an orator to draw a comparison, or simile from it.

The Dr. upon searching among ancient authors, whether or not, the *Testudo* or lyre of the ancients was made of the back, or hollow shell of the tortoise (as the name seem'd fully to import he found that it was a current piece of history generally receiv'd among the ancients, that *Mercury* was the first inventor of the lyre (whence *Horace* in his tenth ode of the first book stiles him *curvæ Lyre Parentem*) and that he made it of the shell of a dead tortoise, he accidentally found on the banks of the *Nile*; and out of several testimonies, Dr. *Molyneux* selects the two following; the first is from *Nicander*, an old physician and a Greek poet, who writ above 100 years before *Horace*; in his poem call'd *Alexipharmaca* speaking of the antidotes proper against the poison of the salamander, he recommends both the sea and the mountain-tortoise in these words,

Αμμιγδην ἀλίοιο καθεψήθετα χελωνῆς
 Γυίοις ἢ ταχίνοισι διαπλάσι πτερυγίσσιν
 Ἄλλοτε δ' οὐρεῖς κυτίσθημι ἢ τ' ἀκακῆτα
 Ἀυδῆσσαν εἶηκεν ἀναυδῆτον περ ἰούσαν
 Ἑρμείης, ζαρκευ γὰρ ἀπονοσφίσι χελίον
 Ἄσιλον, ἀγκωνας δὲ δύω παρεταίσα πάζαις.

Translated by *Joannes Gorraeus* into *Latin* thus:

Cum curvâ auxilio veniunt testudine —
 Quæ pelagi fluctibus velocibus innatat alis,
 Aut montano etiam cytiso quæ vescitur & quam
 Reddidit e mutâ modulanti voce canoram
 Mercurius, picto infantis qui cortice carnem
 Exemit, geminumque Ancona intendit in oris.

Grevinus in his treatise *de Venenis, Cap. de Salamandra*, p. 119, gives us a comment on these verses, and relates at large the history of the first lyre; and it is observable that this verse

Αὐδῆσαν, &c.

Reddidit é mutâ modulanti voce canoram —

is so apposite to the present purpose, and comes up so close to Horace's thought

O mutis quoque piscibus, &c.

that it does not only explain the true meaning of it, but makes the Dr. inclinable to believe the Roman might have in his view this very passage of the Greek poet, when he writ these lines; and Horace uses the same allusion, tho' not so fully and expressly, in his eleventh ode of the third book, where he invokes his lyre.

Tuque Testudo resonare septem

Callida nervis

Neque, loquax olim, neque grata —

The other instance is from one of *Lucian's* dialogues, who writ above 100 years after *Horace*; whence it is plain, that the mechanism of the ancient lyre, and the opinion concerning its first invention prevailed since, as well as before *Horace's* days; *Lucian* in this dialogue introduces *Apollo* and *Vulcan* talking (after his jocose manner) of *Mercury* to this purpose.

Απ. χελωνην πρ νεκρον ευρων, οργανον απ' αυτης συνεπηξατο, πηχης γαρ εναρμωσας, η ζυγωσας, επειτα καλαμους εμπηξας, η μαγαδιον υποδεις, καλα εντειναμενος επτα χορδας, μελωδει πανυγλαφους ο Ηραιστε, και εναρμονιον.

Ap. Testudinem mortuam alicubi offendens, instrumentum ex ea cohcinnavit, brachia enim adaptans jugum opposuit, deinde clavos insigens & Hemisphærium repandum infra subjiciens, septem chordas extendebat, atque modulabatur quiddam valdè sonorum, O Vulcane, & ad Musicæ melodiam compositum.

Plate VI. Fig. 15. represents the ancient *Lyra* or *Testudo*, taken from Father *Mersennus lib. 1. de Instrumentis* p. 7. which he tells us he copied from the sculpture of an antique gem, that belonged

that the trumpets of old, were at first made only of rude horns of beasts; and sometimes of the common *Buccina*-whelks, or large sea-shells; hence *Virgil*,

Rauto strepuerunt cornua cantu.
and *Perseus*

Buccina jam priscos cogebat ad arma Quirites.

And afterwards when the *Romans* had enlarged their empire, were become more polite, and all their mechanical arts had received mighty improvements; tho' they had then learnt to make these instruments of different and more commodious shapes, and of quite other sorts of materials, yet, still they retain'd their old names; and this was also the case of the *Testudo*; for it is very manifest, that in succeeding ages, as the skill of the mechanic artist, that wrought and contriv'd the lyre, as well as that of the musician that us'd the instrument, arriv'd at a greater perfection; the model of the old *Testudo* was much alter'd, the number of the strings increased, and the shape so mightily diversified, that at length, they wholly laid aside the tortoise-shell; and the sonorous part or belly of the lyre was made of such different shapes that they bore not the least resemblance to its first model; this appears from those other schemes *Mersennus* gives in the same table of the several sorts of the ancient lyres (but these the Dr. takes to be more modern than that which is here express'd) and from those described by *Leonardo Agostini*, in the second part of his collection of the *Gemme antiche*, which shews us, that as the fancy of the workman, the mode of the times, real convenience or imaginary beauty in the instrument determined it, they were fashion'd into various shapes, and frequently like the lamps of old, into fantastical odd figures.

A Plumb-stone in the Guts for 30 Years, &c. by Mr. Yonge.
Phil. Trans. N° 282. p. 1279.

SARAH Swayn, of a thin habit and middle stature, when but six years old, was first afflicted with a violent pain, together with a large hard swelling on the left side of her belly, which lasted 12 hours and then went off without the use of any remedy, or sensible evacuation; and at the end of three months it return'd, continued and went off as before; it observ'd that period for several years, and then it changed its intermission from three months to three weeks and continued so, till she was 33 years old; in which time she married and bore one child, the
pain

pain of which she averr'd to be much less than what these paroxysms gave her; during her pregnancy, neither her pains, nor her intermissions had any alteration; and in her whole life she found no diet disturbed her, but milk and salt meats; about nine months before she was cur'd, the pain increas'd, and the tumor became as big as a man's two fists; she had endeavour'd to get ease by several remedies, but all in vain, till her agony and watchings had weaken'd her so, that she could not rise out of her bed: In this condition she was advis'd by a woman to take a dose of powder'd jalap, it operated violently, and suddenly drove the pain from her side down to the *Anus*, where it resembled a *Tenesmus*, viz. a constant and violent inclination to stool, without being able to force any thing off; and after she had been thus afflicted for four days, there was also a suppression of urine, and two days after that, Mr. *Tonge* was call'd; he perceiv'd by the account given him, that something obstructed the passage of her *Fæces*, and he soon found it so by a probe; he then anointed the passage with *Populneum*, and taking hold of the substance with a pair of large forceps he extracted it; abundance of wind and *Fæces* gush'd out, and continued to flow till her guts were emptied of all the matter, which had been so long retain'd therein; after which, he ordered her an anodyne glyster and a composing draught; and for several years after, she continued well; the substance extracted was round, somewhat oblong, having some such impressions on it, as men's fingers make on wax, or plaister: it weigh'd then 10 drachms, but afterwards scarcely an ounce; it was five inches in circumference; altho' it felt, and otherwise appear'd like a stone, yet it swam on water; upon cutting it into two with a knife, to view the inside, it appeared externally black and smooth, as if it had been varnish'd, and no thicker; next to this was a crusty substance like brick, half a crown thick; within that appear'd a substance resembling pasteboard; and within that lay a prune, or wither'd plumb, with the stone and kernel cut asunder by the knife: Thus all these surprising symptoms which so long afflicted this patient, were occasion'd by swallowing this plumb-stone so many years before; but how those different accretions were made to it; how it ceas'd to afflict her at so many and at such different intervals; where it lay conceal'd between those fits, and how the pain and tumor observed such regular periods for so many years; at first every three months, and afterwards every three weeks? are questions Mr. *Tonge* leaves to others to resolve.

Several

Several authors tell us of various stones ejected by stool, and several of them have been found to come from the gall-bladder of persons in the jaundice: Mr. Yonge had seen two such stones, bigger than any he ever read of; one as big as a pullet's egg, which proceeded from a lady in the operation of a strong cholagogue; taken for a jaundice, that had baffled several other remedies; the other as big as a large nutmeg, voided by the same means from an aged man, languishing under the same distemper; and both these patients, for several days after those stones came away, evacuated large quantities of choler by stool, and so got clear of the disorder.

That these two stones were generated in the *Folliculus fellis*, or *Ductus choledochus*, appears, if we consider the consequence, and that in colour, taste, weight, and shape, they resemble such as are found in those parts upon dissection of bodies affected with the jaundice; Mr. Yonge once saw near a handful of them taken out of the gall-bladder of the *Portuguese* Ambassador, who died at London 1679; and we are told by *Baglivius*, that the famous *Malpighi* was full of them; they are usually of a sub-citron colour, resembling bright myrrh, and seem to be an aggregate of small stones, which, perhaps, are generated singly in the *Vesicula*, and coalesce in the *Ductus*: The consequence of their coming off shews, that they caused the jaundice in those two last mention'd persons, by obstructing the channels thro' which the bile passes from the common receptacle into the *Duodenum*; it may, perhaps, seem impossible to some, that substances of that bulk could pass thro' a *Meatus* so small as the common *Ductus* is; but Mr. Yonge dissected a physician, who died of the jaundice, and found the *Ductus communis* wide enough to admit his largest finger.

The stones, which are generated in the guts, are of another sort, and easily distinguishable from the foregoing; *Beckers* speaking of some stones voided by stool, says — *Calculos illos in Intestinis genitos esse, quia colore, pondere, & figurâ a choledochis lapillis distincti, arbitratus sum; i. e.* He supposes that these stones are generated in the intestines, because they differ from those in the gall-bladder, in colour, weight, and figure. Those generated in the gall cause the jaundice, those in the guts, beget colic, splanchical, hypocondriacal, and sometimes nephritic pains, all which vanish, as soon as they are ejected.

Mr. Yonge had seen stones as big as a tennis-ball taken out of a bullock's guts; the authors of the *German* miscellany write of one much bigger; *L. Riverius* gives an account of a man, who,
by

by all his stools, continually voided stones like those generated in the kidneys; *T. Bartholine* mentions several stones, one particularly remarkable, as big as a pigeon's egg, which was purged off from a woman by a gentle dose of physick; *Ad. Med. Vol. 1. Obs. 110. V. 5. Obs. 6.* — *in exteriore superficie sub-cinereum, & dum a me clavo ferreo in duas æquales partes diffringitur interius instar chrystalli albicantem & rutilantem, ita ut qui olim ex Ennii stercore aurum, hic colligere potuisset gemmas; i. e. its outside was somewhat of the colour of ashes, but being divided into two equal parts, its inside appeared white, and sparkling like chrystal.* There are several such instances in the *Miscell. Curios. Vol. 7. Obs. 9*; but there is one much more so in *Ambr. Pary. Lib. 25. Cap. 19*, tho' neither of them had so strange a cause or effect, as that mention'd by Mr. Yonge.

Besides the moderns, *Galen, Crato, Sennertus, M. Donatus, Z. Lusitanus, Fernelius, G. Horstius, Schenckius*, and several others have informed the world of stones generated in, and ejected from the intestines; but none with such surprising circumstances as this mention'd by Mr. Yonge.

A person in *Lancashire* had been ill for several years of the cholic, and received no relief from any medicine; being dissected, after his death, there was taken out of one of his guts a large ball six inches round, weighing an ounce and a half, composed of a spongy substance, which swam in water, and viewed by a microscope, it appear'd to consist of very small transparent hairs, or fibres, wrought together, after the manner of the *Tophus bovinus* extracted out of the maws of oxen; in the middle of it was a common prune, or plumb-stone, which having been swallowed, and sticking somewhere in the guts, had gathered that substance about it, which resembled the small hairs on the skins of several animals, or the fibres of plants we eat; and upon cutting it, it was found to consist of a hairy, or fibrous substance, in various layers, over a plumb-stone, which seem'd to be of the same substance with that mention'd by Mr. Yonge.

Dr. Cole had some balls smaller than the two above-mentioned, which had plumb-stones in their centres; the person, on whose account the Dr. was consulted, had had the cholic to a great degree, and had voided several of them; they were not so spherical, but of a compressed figure, smooth and glaz'd on the outside, as some of the *Tophi bovini* are; and within, they seem'd to be of the same substance with the former, in different layers upon a plumb-stone.

Dr. *Thompson*, in his *Experimenta admiranda*, p. 67, gives a large account of a ball which had been voided by a patient after a great fit of illness, of the same bigness, and in appearance of the same substance with the former; that author tells us, it had several plumb and cherry-stones in it: These balls seem to be formed something after the manner of bezoars, which generally have some seed for their centre, or *Nucleus*, on which are formed coats of another substance.

These instances are sufficient to shew the folly of the common opinion; viz. that the stones of fruit are wholesome; for, tho' the guts are by nature so defended by the *Mucus* of the intestines, that people suffer very seldom thereby; yet, if we consider the various circumvolutions of the guts, their valves, and cells; as also, the hair of the skins of animals we feed on; the wool, or down, on herbs and fruits; the fibres, vessels, and nerves of plants which are not altered by the stomach, the like case may very easily happen: A certain patient had a surprising, obstinate, and long disorder that proceeded from a great quantity of strawberry-seeds, which had lodged themselves in the guts, and after their discharge, he was relieved; and several have lost their lives by swallowing a quantity of cherry-stones.

The Vestigia of a Roman Town at Adel in Yorkshire;
by Mr. *Thoresby*. Phil. Transf. N^o 282. p. 1285.

THE vestiges of a *Roman* town are to be seen upon the moor near *Adel* mill, four miles from *Leeds*, and they were accidentally discovered by a farmer, who ploughing part of his farm, was retarded by a great quantity of stones, which lay immediately below the surface of the ground, and which he was oblig'd to dig up before he could proceed; at a very little distance is a *Roman* camp pretty entire, it is above four chains broad, and five long, surrounded with a single *Vallum*, which from the top of the *Agger* to the bottom of the trench is still 22 foot deep, where Mr. *Thoresby* measur'd it; the town seems to have been of considerable note, by the inscriptions, and fragments of statues, pillars, &c. dug up there, all which (as Dr. *Lister* has truly observ'd of most of the *Roman* monuments in these parts) are made of the common sort of coarse rag, or millstone grit, of which are also the remains of a large aquæduct, being stones of a great length, and about $\frac{3}{4}$ of a yard thick, wherein the passage for the water is about six inches broad, and as many deep, almost double to those of clay found in the *Roman* burying-place at *York*; a statue was dug

dug up here, to the full proportion of a *Roman* knight or officer, with an inscription thereon; there were also discover'd two inscriptions; the one was only a fragment, which yet had enough to shew that it was sepulchral, by the H. S. E. for *hic situs est*, below PIEN TISS; the other was almost entire and plainly appear'd to have been a funeral monument, it begins as usual, with *Diis manibus sacrum Cadiecina Fortuna Pia*; and ends *Vixit Annos X*; it is a foot thick, two foot broad and three foot high; the letters are very large, full three inches long, some of them interwoven, as AND AD and ED (as Mr. *Thoresby* supposes the EO to be) in *Candiediana*, the form of the letters, and particularly the A may, perhaps discover the age this *Roman* station flourish'd in; viz. in *Severus's* reign *An. Dom.* 194 or before, if the observation of Mr. *Cambden* in his *Britannia* p. 808, holds good, from which none of the modern critics dissent; 'this observation, says he 'I have made, that from the age of *Severus* to that of *Gordian*, and after the letter A in the inscriptions found in this 'island, wants the cross stroke, and is engraved thus A'.

This *Roman* station was destroy'd, probably, by fire (as may be conjectur'd from the flag and adust colour found in some places) in some of the insurrections of the native *Brigantes*, who were impatient of restraint; amongst the ruins were found two or three mill-stones for grinding corn, which, by the smallness of the size, being 20 inches in diameter, shew that the *Romans* of those, as well as the *Egyptians* and *Jews* of former ages, made use of their slaves, or captives for that drudgery, who were plac'd *post molas*, *Exod.* xi. 5. *non precedunt, sed sequuntur, brachiis & toto corpore trudentes*; and what the old MSS. bibles have in respect to *Sampson*, *Judg.* xvi. 21. *clausum in carcere molere fecerunt*; our *Saxon* predecessors render expressly *banhc pypne*, Mr. *Thwait's* *Hept. Anglo-Sax*; besides this, which was entire, Mr. *Thoresby* had a fragment of another mill-stone, whereon the rows were still remaining, which being heavier, and almost as thick at the circumference, as the other is at the centre (for they are convex on one side) Mr. *Thoresby* supposes might have been the *Runner*: The learned *Gataker*, in his notes on *Isai* xlvii. 2. observes, that the original word is of the *Dual* form; and that the law, prohibiting to take the mill-stone to pledge, does particularly mention *Receb*, or the *Rider*; because, that lying loose might be the more readily taken off, and carried away upon that occasion; and in his annotations upon *Lament.* v. 13.

they took the young men to grind; he says, that the *Talmudists* have a story, that the *Chaldeans* oblig'd the young men to carry mill-stones with them to *Babylon*, where there was a great scarcity of them; whence probably, their paraphrase renders that text, *have borne the mills, or mill-stones*, which might be true in a literal acceptation; they have also a proverbial speech of a man with a mill-stone about his neck (alluded to in *St. Matth. xix. 6.*) used to express one that lies under an exceeding heavy, and almost insupportable burden.

Mr. *Thoresby* found here the fragments of urns, and other *Roman* vessels; one of which was 23 inches, or 2 foot in circumference; most of them were of the common red clay; and he also had one of the best coral-colour'd varnish, and others of a bluish-grey, as also a brass ring found in the same place: The *Roman* ridge, on which this town stood, comes from the large military road upon *Bramham-moor*, of which *Leland*, in his *M.S. Itinerary* affirms; 'I never saw, says he, in any part of *England* so manifest a token, as here, of the large crest of the road of *Watling-street*, made by hands'; from thence this *Via vicinialis* passes by *Thorner* and *Shadwell*, *Street-lane* and *Harwaster-ridge* upon *Blackmoor* (near which is the *Roman* pottery, mentioned *Phil. Transf. N° 222.*) to *Adel*; from thence thro' *Cookridge* over the moors towards *Ilkley*, a known *Roman* station; this same ridge is very evident in some part of the ground of *Tho. Kirk* of *Cookridge*, Esq; who shewed Mr. *Thoresby* the place where a *Roman* monument was dug up, which seem'd to have had a large inscription, but so cras'd that nothing distinct could be made of it; perhaps, the said *Cukeryg*, as it is called in the original letters patent of King *Edward VI.* to archbishop *Cranmer* (in the possession of the gentleman above) was so denominated from this *Roman* ridge, which passes directly thro' it; but, what the name of this station was, Mr. *Thoresby* cannot imagine: Dr. *Gale* gave him an account, from an anonymous geographer, of a station in these parts called *Pampocatia*, which he thought should be read *Campocatia*, and had sent to *France* for various readings, concluding; 'Where to place this I know not, but I am hopeful you will be so happy as to find it, and so kind as to make the discovery', &c. Now considering, that in the said author, printed at *Ravenna, An. Dom. 1688*, this *Pampo*, or *Campocatia*, is the very next station to *Lagentium* or *Legeolium*, it seems not improbable that this camp, &c. was the very place; but as things, so many ages past,

past, admit of various conjectures, Mr. *Thoresby* offers another, which he was inclined to, from the similitude of the names, the *Agel* or *Adelocum* of the ancients, and present *Adle*, or *Adel*, as it is in the *Monasticon Anglican*. It is true, that it is sometimes writ *Segelocim*; but, as Mr. *Burton* well observes, in his comment on *Antoninus's* itinerary, it is to be reckoned amongst those words, to which the ancients sometimes put an S or *Sibilus*, and sometimes omitted it; if this be thought too northward for that station, which is placed south of *Danum*, it may be replied, that, not to insist upon the transposition of some places, of which there are instances in the itinerary; Mr. *Thoresby* sees no inconveniency in admitting, that the *Romans* might then, as we at this day, have several towns of the same name; thus, from an altar which Mr. *Thoresby* had inscribed *CONDATE*, the said Dr. *Gale* concludes, that *Cousley* near *Piersbridge*, where this altar was found, was as well called *Condate*, as *Congleton* in *Cheshire*; and it seems highly probable to Mr. *Thoresby*, that the legions, being detach'd against the enemy to distant places, might endeavour to leave such memorials of their removes: Thus, the *Legio vicesima valens Victrix*, usually quarter'd at *Deva*, or *West-Chester*, was detach'd to *Westmorland*, as appears by an inscription; and Mr. *Thoresby* does not question, but that the *Lingones*, who were seated at *Ilkley*, were also at *Lingivel* near *Thorp on the Hill*, where the *Roman* coining-moulds in *Phil. Trans.* N^o 234, were found; and that the intrenchments there were so denominated from them, the *Roman Vallum* being pronounced *Wallum*, of which see *Causabon*, *Somner*, &c. At this *Agelocum*, or *Adelocum*, as *Cambden* himself once read it, is a church of the most antique form Mr. *Thoresby* ever saw, and, being built of small square stones like the *Roman* wall, and multangular tower in *York*, he took it to be the remains of some *Roman* temple, till he found therein some *Christian* histories; particularly, the descent of the Holy Ghost in the form of a dove, done in *basso relievo*, but in so very rude a manner, as sufficiently evinces their great antiquity; the inhabitants have an old tradition, that *Adel* church once stood upon *Blackhill*, the place where these *Roman* monuments were discovered, occasioned perhaps by the removal of the stones from some publick edifice at the destruction of the old *Roman* town.

Of Secretions in an Animal Body; by Dr. Morland. Phil. Trans. N^o 283. p. 1293.

THE whole business of animal secretion seems to Dr. Morland to be reducible to this double enquiry: 1. How a thin fluid, such as is the urine, may be separated from the mass of blood, and the remaining parts of the blood return again to the heart? 2. How a thick fluid, such as is the bile, or *Semen*, may be separated from the mass of blood, and the other fluids, both thinner and thicker than this particular fluid to be separated, return again to the heart? To make the thing plainer, the Dr. gives a general idea of the structure of the glands; and a gland, he takes to be compos'd; 1. Of the ramifications of the blood-vessels inclos'd in a common membrane, which sends off several fibres, by which these minute vessels are tied together; and that the veins are a continuation of the arteries; of this Dr. Areskin has fully convinced us, by an injection of wax in a human subject, so dexterously perform'd, that the wax being injected by the arteries, fill'd the veins at the same time; and afterwards, by a nice dissection of the part, where the continuation of the small ramifications of the arteries and veins appeared to the naked eye. 2. Dr. Morland supposes, that when the branches of the arteries begin to grow very small, they send off several ducts, whose orifices are of different dimensions; and these ducts are of two sorts; the 1st of these, which in the same artery, are always smaller than the 2^d, pass immediately from the artery, and open into the veins; the 2^d, which passes off nearer to the extremity of the arteries, unite, and carry off a liquor from the mass of blood, for particular ends in several parts of the body; it is to be observ'd, that in one case the 2^d sort are only to be found: The Dr. supposes that a thin fluid may be secern'd from a thick one, when the orifices of the secretory ducts are so small, as to admit no other but that thin fluid; and that at the same time, the remaining parts of the blood which are thicker, continue their course in the vessel; again, he supposes, that a thick fluid may be secern'd when the thinner parts are carried off some other way, so that the liquor to be secern'd, will be the thinnest of the remaining mass; upon these principles, the Dr. thinks it will be easy to explain the doctrine of secretions: And now, in the 1st place, let us examine how the thinner secretions are perform'd, as for instance, the urine; when the blood, by the contraction of the heart, is propell'd into the
arteries,

arteries, they are dilated, and again contracting themselves, they push it forwards into all the parts of the body; and amongst the rest, into the ramifications of the arteries, of which the glands of the kidneys are composed; by this means, the blood passes by the orifices of the secretory ducts; when these arteries contract themselves, they press the blood, and force the thinner parts into the orifices of those ducts (which will admit no thicker fluid) and carry it towards the *Pelvis*, and the remaining part of the blood into the veins, by them to be return'd back to the heart; and thus, a thin liquor may be separated from the mass of blood. In the 2d place, let us examine, how a thick liquor may be separated from the mass of blood, where thinner liquors are mix'd therewith; for instance, let us take the gall or *Semen*; when the blood is push'd into the celiac or mesenteric arteries, it is forced to pass into the glands of the stomach, pancreas, spleen, and intestines, &c. where the *Liquor Gastricus*, *Succus Pancreaticus*, *Liquor Intestinalis* are separated by the above-mention'd method; the blood, being thus divested of various thin liquors, is push'd on into the veins corresponding to these arteries, which veins unite, and form a large trunk called the *Vena Porta*, which entering into the substance of the liver, by its small ramifications, chiefly forms the glands, of which the liver is composed; here again, all the fluids contain'd in the *Vena Porta*, which are thinner than the bile, are separated from this mass of blood, by the first sort of secretory ducts (which were said to open into the veins) and there they are discharged and mixed with the blood, which is passing on towards the heart; at the same time the bile, with the rest of the blood, which is thicker, continues its course in the artery; and now, all the thin liquors being separated, the bile is the thinnest part of this mass of blood, and so it may be received by excretory ducts, which are capable to receive it, and no other.

The *Semen*, being a very thick liquor, is separated much after the same manner, viz. the blood, being push'd into the spermatie arteries, passes into the substance of the *Testes*; where all the liquors that are thinner than that, out of which the *Semen* is to be taken, are separated by the 1st sort of secretory ducts, and carried back to the mass of blood; then, this *Liquor Seminalis*, being the thinnest part of the remaining mass, is separated by secretory ducts, capable to receive it, and no other; after that, the *Liquor Seminalis* is separated from the mass of blood by the aforesaid method, it is push'd
for-

forwards into the secretory ducts, where there are other ducts, which take their origin all along from them, which ducts are capable of receiving the thinnest parts of the *Liquor Seminalis*, and convey them to the mass of blood; and thus, the *Semen* is left behind to pass into the *Vas deferens*; and it is worth observing, that as the *Semen* grows thicker and thicker, by continual separation, the canal in which it is to run, grows larger and larger, as appears by the structure of the *Testes Epididymis & Vas deferens*; hence we may give a true account, why the canals of which the *Testes* are composed, are so long, viz. that there might be time enough to separate all the thin fluids: By this method we see, how the thickest and thinnest fluids may be separated from the mass of blood; and how intermediate liquors may be separated after the same manner, by canals of intermediate dimensions; thus, in a word, the whole doctrine of secretions may be reduc'd to this, viz. that in order to separate a liquor of any determin'd thickness, all the fluids, which are thinner, must be carried off by small canals, and the liquor to be separated, being the thinnest of the remaining mass is discern'd, because the ducts are capable to receive it, and no other.

Corrollaries. 1. Hence, the use of the spleen is evident.
 2. Hence appears the origin and use of the lymphatics.
 3. Hence the texture and use of several minute parts of the body may be discovered, which hitherto have been unknown.

Worms in Human Bodies; by Dr. Bononio. Phil. Trans. N° 283. p. 1296.

HAVING frequently observ'd that poor women, when their children are troubled with the itch, do with the point of a pin pull out of the scabby skin little bladders of water, and crack them like fleas upon their nails; and that the scabby slaves, in the bagnio at *Leghorn*, do often practice this mutual kindness upon each other; the Dr. proposed to examine what these bladders might really be; upon asking an itchy person, where he felt the greatest, and most acute itching, he pointed to a great many little pustules not yet scabbed over, of which picking out one with a very fine needle, and squeezing a thin matter from it, the Dr. took out a very small white globule, scarcely discernible; upon observing this with a microscope, he found it to be a very minute animal, in shape resembling a tortoise, of a whitish colour, a little dark upon the back, with some thin and long hairs, of a nimble motion, with

with six feet, a sharp head, and two little horns at the extremity of the trunk, as represented in Plate VI. Fig. 17. and 18: The Dr. repeated the enquiry in several itchy persons of different ages, complexions, and sexes, and at different seasons of the year; and he found in all the very same animals, and that in most of the watery pustules; for, now and then, in some few he could not see any; and tho' by reason of their minuteness and colour, being the same with that of the skin, it is hard to discern these animals upon the surface of the body, yet he has sometimes seen them upon the joints of the fingers, in the little furrows of the *Cuticula*; where they first begin to enter with their sharp head, and by thus gnawing and working in with their bodies, they cause a very troublesome itching, till they are got quite under the *Cuticula*; and then, it is easy to see how they remove from place to place by their biting and eating; a single one sometimes makes several pustules, of which the Dr. had often found two or three together, and for the most part pretty near each other.

The Dr. very carefully examined, whether or not these *Animalcula* laid any eggs; and after several enquiries, at length he saw drop from the hinder part of one of them a very small, and scarcely visible, white egg, almost transparent and oblong, resembling the seed of a pine-apple, as represented Fig. 19. and 20; he often found these eggs afterwards, from which, he doubts not, these *Animalcula* are generated, as all others are; that is, from a male and female; tho' he could not by any difference of figure distinguish their sex.

From this discovery it may be no difficult matter to give a more rational account of the itch, than hitherto hath been done; it being very probable, that this contagious distemper owes its origin, neither to the melancholy humour of *Galen*, the corrosive acid of *Sylvius*, the particular fermentation of *Van Helmont*, nor to the irritating salts in the *Serum*, or *Lympha* of the moderns, but rather to the continual bitings of these *Animalcula* in the skin; by means of which some portion of the *Serum*, ouzing out thro' the small apertures of the *Cutis*, little watery bladders are produced, within which the insects continuing to gnaw, the infected person is forced to scratch, and by scratching he increases the malady; and thus repeating the troublesome work, he not only breaks the little pustules, but likewise the skin, and some small blood-vessels, and so causes scabs, crusty sores, and such like foul symptoms: From hence also we come to understand, how the itch comes to

be a distemper so very catching; since these animals, by simple contact, can easily pass from one body to another, their motion being exceeding swift, and crawling as well upon the surface of the body, as under the *Cuticula*, they are very apt to stick to every thing that touches them; and a few of them being once lodged, they multiply apace by the eggs which they lay; nor is it any wonder, if this infection is propagated by means of sheets, towels, handkerchiefs, gloves, &c. us'd by itchy persons; it being easy enough for some of these creepers to be lodged in such things as these; and indeed, the Dr. has observed that they will live out of the body two or three days; nor, in the last place, shall we be at a loss to know the reason of the cure of this malady by lixivial washes, baths and ointments made up with salts, sulphurs, vitriols, mercurys, simple precipitate or sublimate, and such sort of corrosive and penetrating medicines, these being infallibly powerful to kill the vermin lodged in the cavities of the skin; which scratching will never do, partly by reason of their hardness, and partly because they are so minute, as scarcely to be found out by the nails; neither do inward medicines perform any real service in this case, it being always necessary, after a tedious use of these, to have recourse to those external ones already mention'd; and if in practice we often experience, that this distemper, when we think it is quite cur'd by unction, does yet in a short time return again; this is no ways surprizing, since tho' the ointment may have kill'd all the live *Animalcula*, yet probably, it may not have destroy'd all their eggs, laid as it were, in the nests of the skin, from which they may afterwards breed again, and renew the distemper; and upon this account it is very advisable, after the cure is once performed, still to continue the anointing for a day or two more; which may be done the more readily, because these liniments may be made agreeable enough, and of a good smell; as particularly, that compounded of the ointment of orange flowers or roses, and a small quantity of red precipitate.

A piece of a Dog's Gut cut out, and cur'd; by Mr. Shipton. Phil. Trans. N^o 283. p. 1299. Translated from the Latin.

IT is an opinion handed down from remotest antiquity, that wounds in the thick guts are generally mortal, but in the thin ones, always so; *Hippocrates Aph. 18. and Aph. 24. Lib. 6.* passes an unfavourable judgment on them; as also *Celsus Lib. 3. Cap. 26. and Lib. 7. Cap. 16;* and *Fabritius ab Aquapendente,* the prince of modern surgeons, *Operat. Chirurg. Cap. 53. giving*

ing an account, why the method of sewing the guts was omitted by *Galen* and *Paulus*, confirms this judgment from his own experience: It is true, *Paul Barbette* asserts that a wound in the thin guts has been sometimes cur'd; of which he could, he says, give a remarkable instance, *Chirurg. Part. 2. Lib. 2. Cap. 11.* yet, it were to be wished that he had given posterity a more particular account of a case so uncommon and so contrary to the sentiments both of the ancients and moderns, that we might form a more certain judgment about it; and it is surprising that none of his co-temporary physicians ever mention'd such a remarkable cure: Tho' all agree that a wound in the human intestines is very dangerous, yet it is not so in dogs; as appears from the following experiment: Mr. *Shipton*, having tied a dog as usual, made a pretty large wound in the *Abdomen*, then pulling out a part of the *Ilium*, he tied up the meseraic vessels, which convey blood thereto; and cutting the gut transversely in two places with a pair of scissars, he took away about two fingers length thereof; then with the skinners suture he sewed up the wound in the gut, and with the interrupted suture that of the *Abdomen*, which he cover'd with a plaister, and untying the dog, he rolled bandages round the part; at first the dog seem'd to reel, as if he had been seiz'd with a *Vertigo* or dizziness, and to be very weak; and the same night he vomited twice; in a few days after, the stitches slackening a little, they were braced up tighter, and afterwards taking off the plaister and bandages, in about three weeks time, the dog by licking the wound, made it cicatrize; the retraction of the gut, as soon as it was cut, was very observable here, elegantly resembling a sphincter; in some weeks after the dog was perfectly recovered, and lively, Mr. *Shipton* hang'd and open'd him; when he found that the part of the gut, where it was sew'd, strongly adher'd to the *Peritonæum* at *f* Plate VI. Fig. 21. in the left *Hypocondrium*, (at a good distance from the external wound, which had been made in the right *Hypogastrium*) and it was form'd into a large bag DDD; the *Omentum* G did also adhere thereto, and the intestines thereabouts coalesced together in several places, as **ee: In order to view the *Cicatrix* on its internal side *c*, the more exactly, he cut the gut lengthwise; and it appear'd that the lips of the wound were on one side DDD united and connected with the *Peritonæum* *f*, and on the other side divided, and strongly adhering to the adjoining intestines; in such a manner that their external coats, forming the internal *paries* on that side, served to form the continuation of the intestinal duct, and to protrude the ali-

ments: *Brunnerus*, in *Præfat. ad Experim. nova circa Pancreas*, mentions his having wounded a dog an inch and a half in one of the thin guts, who afterwards recover'd, tho' with some difficulty: Mr. *Cowper* perform'd the like operation with more success; for *Phil. Transf.* N° 208. he says, that dividing lengthwise one of the thin guts in a large dog; he had in a short time cur'd him, without stitching the gut, only sewing up the *Abdomen*, and without any dangerous symptoms; and that either with or without Dr. *Colbatch's* styptic powder, which was then much cried up; yet it does not appear, that in either of those cases the gut was cut quite thro', or any portion of it taken away: Dr. *Wallis* mentions an instance not unlike these, *Phil. Transf.* N° 219. of a horse, who by leaping, had staked himself into the stomach, and had continu'd so for some hours before the farrier came to dress him; who enlarg'd the wound, sew'd up the stomach, and slightly stitched the lips of the wounded *Abdomen*, and put in tents; so that in a few week's after, the horse recover'd.

Tho' these experiments have succeeded well in beasts; yet Mr. *Shipton* does not doubt but that the cutting away one of the thin guts of a man, would be as certainly mortal, as if he was run thro' the heart; for the thin guts in men have not such a strong contexture of fleshy fibres, as those of dogs have; who being accustomed to harder food, seem to require a greater motion and heat in the intestinal tube, for elaborating the chyle and excluding the *Fæces*, which are commonly harder in them than in other animals: Tho' chirurgical operations are not performed on brutes, yet such experiments may sometimes be made on them, as may afterwards become serviceable to mankind; for observing that the guts of a dog, after cutting out a portion thereof, do again coalesce and unite; the wounds in those of a man, at least in the thick intestines, may be sew'd up with the greater prospect of success,

Fig. 21. A *aa* represents the superior part of the *Ilium* towards the stomach; *Bbb* its inferior part; C the *Cicatrix* or scar of the wounded gut on its internal side; DDD the lips of the divided gut; E its superior orifice; F its inferior orifice; *eee* the exterior parts of the adjacent guts, which supply the portion of the gut wanting in this place; *f* the portion of the *Peritoneum* that adhered to the gut; G the *Omentum* that was likewise connected to it; ** the vestiges of the divided gut, where it adher'd to the other; H H the trunk of the *Aorta*; I the *cæliac* artery; g the right gastric; h the right gastro-epiploic artery; i the hepatic arteries; k the pyloric artery; l the *Gastrica*

strica major; *mm* the splenic artery; *K* the superior mesenteric artery; *L* the phrenic arteries; *O* the trunk of the *Vena Porta*; *P P* the ramifications of the arteries and veins in the mesentery.

Green-weeds growing in Water, and *Animalcula* found about them; by *M. Leewenhoeck*. Phil. Trans. N^o 283. p. 1304.

THE green stuff or weeds, which are observed to drive upon the water, are suppos'd by the common people to spring out of the ground from under the water; but *M. Leewenhoeck*, as often as he observed the said weeds, always found that they were produced from seeds of the same kind, like all other trees and plants; he likewise observed, that this green matter does not grow in deep waters, tho' they are narrow, and still; but that wide and shallow waters especially moats and ditches abound therewith; and that the wind does it no hurt; he also found that the green weeds in those ditches, which have but little water, are very small in comparison of those in larger waters, and near the sides of the banks, where they are shallow, and where the water had but little motion: By means of a sluice, the water of the river *Maes* (swelled by the summer-floods) is brought to *Delft* from *Delft-haven*, a town about two hours distance from it, and with this water there comes in a little of this green stuff; *M. Leewenhoeck* having fish'd up about 50 of those weeds, as deep as he could, that he might not break the roots, he put them into an earthen pot, together with a large quantity of their own water; and taking very nicely with a needle out of the pot several of these weeds one by one, he put them into a glass-tube of a finger's breadth which was fill'd with water, and likewise into a smaller tube; and causing the roots of the weeds to subside leisurely, he view'd them with his microscope, and observed a great many different kinds of *Animalcula*; two sorts of which had long tails, whereby they seem'd to be fastened to the roots of the weeds; these *Animalcula* were shaped like a bell, and they moved the small cavity of their bodies in such a manner, that putting the little particles of the water into a commotion, *M. Leewenhoeck* could not see the instruments whereby they produced the said motion; and tho' he had seen 20 of these *Animalcula* together, gently moving their long tails, and outstretch'd bodies, yet they contracted both in an instant, and then softly extended them again; and this kind of motion they continu'd for a great while.

Plate VI, Fig. 22. A BC represents one of the green weeds of a common size, as it lay upon the water, and appear'd to the naked eye.

Fig.

Fig. 24. D E F G shews the very same weed, as it appear'd in the glass-tube, fill'd with water, with its roots extended.

Fig. 25. H I K L M N O P Q R represents a small part of the roots, as it appear'd in the microscope, thro' the whole length of which were to be seen its vessels with their divisions; these roots M. *Leeuwenhoeck* supposes, were of no further use, and in a manner wither'd; they were also overgrown with a great many peculiar long particles, and mostly with little figures like flowers, as represented between K and L; the *Animalcula* resembling little bells are to be seen in I S T and N V W; and he saw above 100 of these *Animalcula*, with their tails fastened to the root, and living between H I K L M; but other roots had none of these; in several of these roots M. *Leeuwenhoeck* observed one, and sometimes (but seldom) two sheaths or cases of several sizes fasten'd in them; the largest is represented by R X Z Y; there appeared out of the same sheath a little animal, the fore-part of whose body was roundish, as in X Z Y; and presently there proceeded from that rotundity two little wheels, that had a swift gyration always one and the same way, as in *abc*; these small wheels were set as thick with teeth, as the wheel of a watch; and when these *Animalcula* had for some time exerted their circular motion, they drew the wheels into their bodies, and their bodies wholly into their sheath, and soon after they thrust them out again with the aforesaid motion; another while they continued shut up in their sheaths; and tho' he had also observed the like wheels in other *Animalcula*, yet their bodies differ'd from each other, and their sheaths were of a darkish colour, so that he could not easily perceive the *Animalcula*; and moreover, they seem'd to be compos'd of globules: M. *Leeuwenhoeck* likewise observed other sheaths, that were several degrees less than those before-mention'd, and as transparent as glass, so that a person might plainly see the *Animalcula* lying within them; P *def* represents the sheath with the little worm P *df* therein; O *gh* shews a sheath with half the body of the *Animalculum* *gh* protruded out of it; and in which, by reason of its exceeding smallness, the wheels could be seen but now and then, and that only when its body was extended, which would soon contract itself; moreover, he observed one of these *Animalcula*, whose body was sometimes extended and sometimes contracted; and about the middle of its body, which M. *Leeuwenhoeck* took to be the lower part of its belly, there was another of the same kind but smaller, whose tail seem'd to be fasten'd to the other.

Fig. 26. A B C D E F G H represents an *Animalculum* about twice as big as it appear'd to the naked eye, whilst it was in the water, and fastened to the root of the green weeds; A the tail wherewith it fastens itself; C D E represents eight horns; whereas, others that were smaller had but six; the animal is drawn as extended at its full length, whereas when contracted, it was not the fourth part so long; Fig. 27. K L M represents a small part of one horn; in Fig. 28. is to be seen an *Animalculum* B H coming out of the body of a larger one; this M. *Leewenhoek* took at first to be a young *Animalculum* fasten'd by chance to an old one; but observing it more narrowly, he saw it was a *Partus*; for whereas this *Animalculum* (when he first discover'd it) had but four very small horns, after the space of 16 hours, it was grown much bigger both in its body and horns, and four hours after that, it was quite excluded its mothers belly; M. *Leewenhoek* observ'd, on the other side of the body of the biggest *Animalculum*, a round little knob of seed between G and I, that from time to time, and in a few hours, grew still bigger, and at last grew pointed; and in 13 or 14 hours it became so large, that you might see two horns upon it; in the space of 24 hours, the last mention'd *Animalculum* had acquir'd four horns, one of which was small, the second larger, and the other two were very large, and were more strongly protruded and contracted than the others; three hours after, this *Animalculum* got clear of its mother: M. *Leewenhoek* endeavouring to pursue his discovery of the generation of these animals, wiped off the green weeds from their bodies, the better to make his observations; but he found that the *Animalculum* was not only dead, but its horns and part of its body quite wasted: Another *Animalculum*, that had brought forth two young ones, had her body laden with another sort of *Animalcula*, whose shape was flat below and roundish above, and which he observed in most waters; and these were above 1000 times less than those they crawl'd upon, and hinder'd their moving; but a much larger *Animalculum*, whose body was almost round, teas'd one of the aforesaid *Animalcula*, not only by running upon its body but by clinging so fast to one of its horns, that whatever effort the other made to get rid of it, she could not shake it off; and at last, M. *Leewenhoek* found she had lost one of her horns in the scuffle; that which seem'd very surprising to M. *Leewenhoek* was, that the said *Animalcula* would sometimes extend their horns to so great a length, that thro' the microscope, they seem'd to be several fathoms in length, as represented in Fig. 29. N O P, wherein are like-

likewise observable the knotty protuberances, as in Fig. 26. K L M; these protuberances seem to be compos'd of seven round globules plac'd together; viz. one in the middle, which was more prominent than the rest, and the others like a rose round it; M. *Leeuwenhoeck* observed in the green weeds abundance of surprising *Animalcula*; some of which feed upon the same green stuff, and to others of them it served instead of sculking holes to hide themselves from the fish, which would otherwise devour them.

To return to the generation of the above-mention'd green weeds; M. *Leeuwenhoeck* had several times observed, that most of the roots are thickest at the extremity, and provided with a great many parts that look like flowers to the eye, with long pipes therein, which he takes to be a gummy excrementitious matter, that by overspreading the whole root, causes it to die, or wither.

M. *Leeuwenhoeck* had often dissected some of these small weeds, which had never produced any others; and he extracted young weeds out of them, which were so very small, that they escaped his naked eye; let us suppose that Fig. 22. A B C is compos'd of three entire weeds, of which that part mark'd A we will call the mother-plant, from whence proceed several roots; first the plant B is immediately produced by the said mother-plant, and join'd to it by a fibre, which as it grows, conveys nourishment to it, till it is provided with roots of its own; before the weed B is arriv'd at its full growth, A has brought forth another mark'd C, and that likewise has no root; now, if we should dissect one of those weeds, tho' they were never so small, we shall find young weeds within them; M. *Leeuwenhoeck* opened one of these immature weeds, and took out such an embryo as is before described; and placing it before his microscope, it was immediately drawn, before its moisture should exhale; for if that should happen, the vessels, thro' which it receives its increase could not be easily described.

Fig. 28. represents a weed M. *Leeuwenhoeck* had extracted out of another, of the bigness of C in Fig. 22; this weed receiv'd its nourishment by that part mark'd S T; between S T inwards you may observe five small particles, which M. *Leeuwenhoeck* supposes also to be young weeds; and that part which lies between S T outwards was likewise a young weed, which had as round and as entire a shape as Q R S T itself; so that from hence it appears, that all these green weeds proceed

reed from a seminal matter, as well as other plants do; that he might satisfy himself still more fully, he caus'd some of these weeds to be taken out of a ditch; but the largest of them were much smaller than the above-mentioned ones, but their leaves were much thicker; having examin'd these weeds, he found, that tho' they were arriv'd to their full growth, they had but two roots, which were longer than the roots of the first weed; and upon viewing the smaller weeds, he could perceive that they had several, tho' very short roots; whilst M. *Leerwenhoeck* observ'd the last weed, he saw a great number of *Animalcula* swimming in circles thro' the water, and they lay so thick together, that even to the naked eye they appear'd like a cloud; M. *Leerwenhoeck* had never seen any of these *Animalcula* in other waters, and next day they were all gone; there were a great many species of these *Animalcula*, and each had their different motions, and they were all so small as to escape the naked eye; amongst these, he observed some that were much larger than the rest, and were coupled together, in which action they lay very quiet on the sides of the glass, till a larger sort interrupted them; whilst they lay quiet, he could easily see those instruments by which they move, as also the motion of several parts of their bodies, which some would take for the circulation of the blood; but M. *Leerwenhoeck* rather supposes it to be the chyle in the guts; these *Animalcula* were so large, that they might be seen in clear water, and in a glass-tube; amongst several of this sort he could perceive some as big as little grains of sand, and as compleatly formed as garden-spiders.

A Water-spout at Hatfield; by Mr. Abraham de la Pryme.
Phil. Trans. N^o 284. p. 1331.

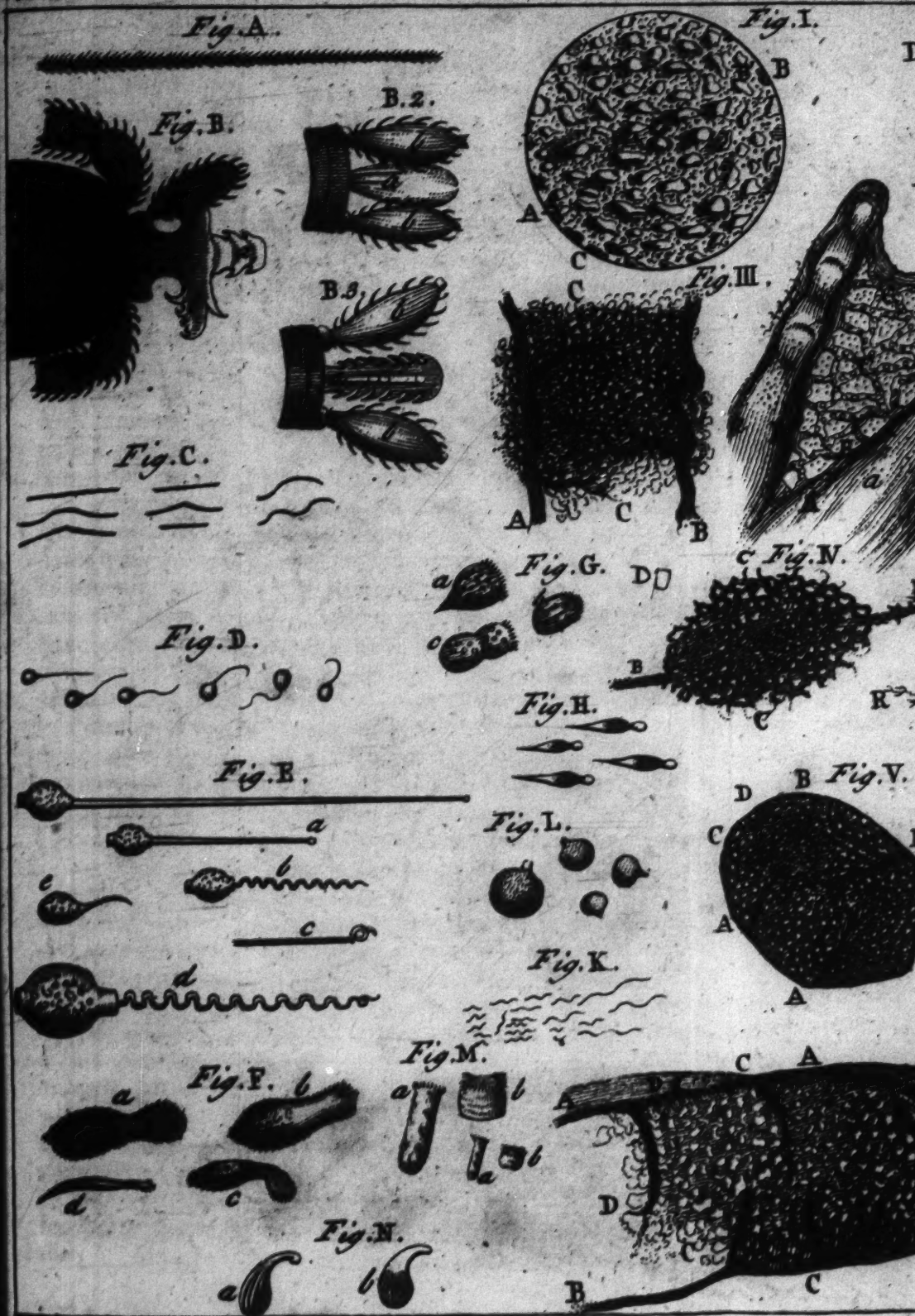
THO' the weather in *June* had been in this part of the country exceeding wet and cool, yet monday the 21st of the said month was pretty warm, and about two o'clock that afternoon, no wind stirring below, tho' it was somewhat stormy higher up in the air, the clouds began to be mightily agitated and driven together; whereupon they became very black, and were very visibly hurried round, from whence there proceeded a most audible whirling noise; some time after, there descended a long tube or water-spout from the center of the congregated clouds, wherein was a swift spiral motion like that of a screw, or the *Cochlea Archimedis* when in motion; it proceeded slowly from west to north-east, broke down a large oak or two,

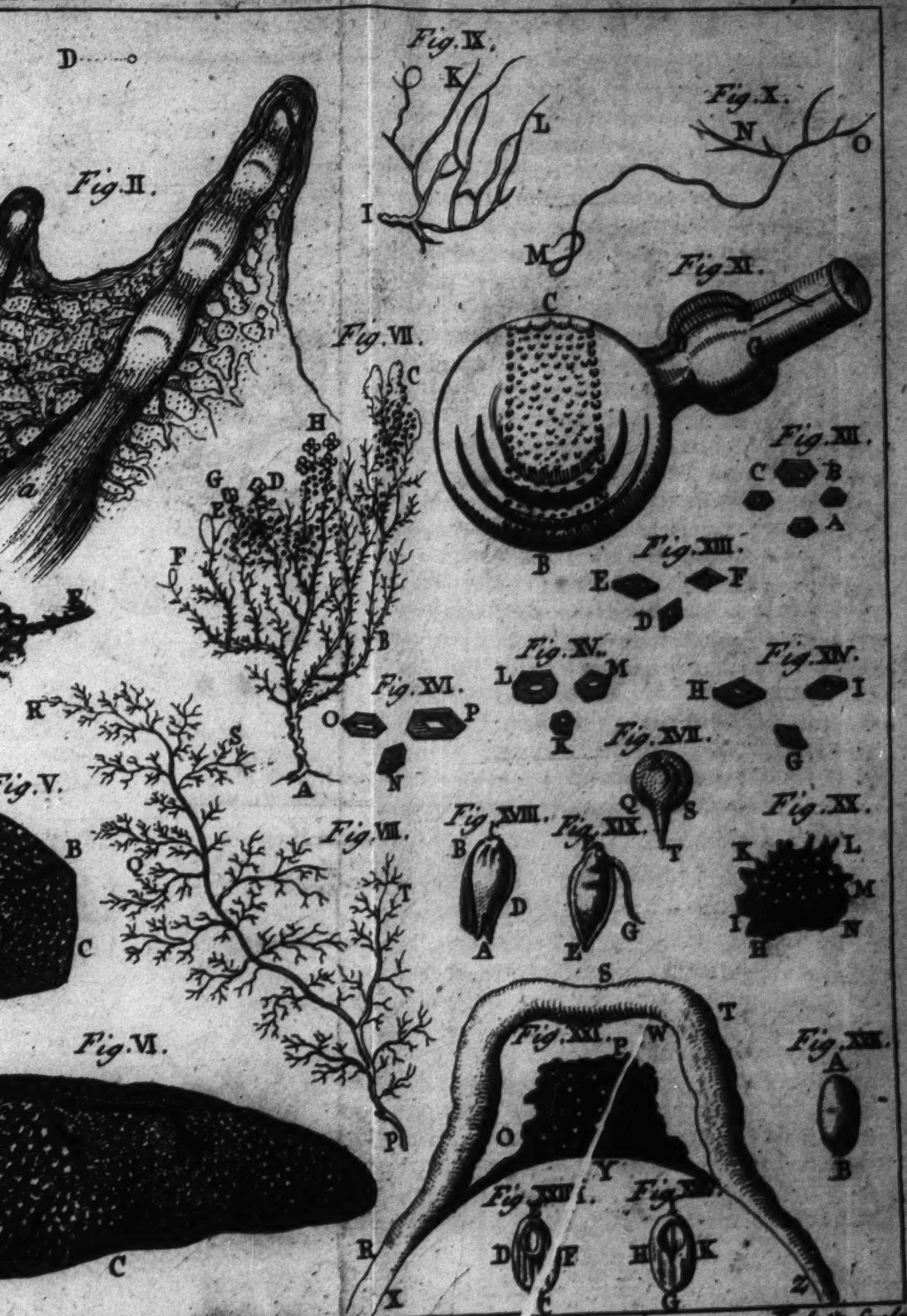
frighten'd the labourers out of the field, and made others lie flat upon their faces to escape being whirled about and killed, as they saw had happen'd to several jack-daws, who were suddenly snatch'd up, carried out of sight, and then thrown a great way off; at length it pass'd over the town of *Hatfield*, filling the whole air with the thatch it took off from some of the houses; then touching upon a corner of the church, it tore up several sheets of lead, and roll'd them together in a strange manner; and soon after, it dissolved and vanish'd, without doing any further mischief; there was nothing more extraordinary in this water-spout, than in that which Mr. *de la Pryme* gave an account of *Phil. Transf. N° 281. p. 1248*; and by all the observations he could make of both, he found that had they been at sea, and join'd to the surface thereof, they would have carried up a vast quantity of water into the clouds; and the tubes would then have become much more strong and opaque than they were, and have continu'd much longer.

It is commonly said, that at sea the water collects, and bubbles up a foot or two high under these spouts before they join; but this is a mistake, owing to the pellucidity and fineness of those tubes, which undoubtedly touch the surface of the sea, before any considerable motion can be produced therein; and that when the tube begins to fill with water, it then becomes opaque and visible; as for the reason of their dissolving of themselves, after that they have suck'd up a great quantity of water, Mr. *de la Pryme* supposes it to be owing to the great quantity of water carried up, which must needs thicken the clouds, impede their motion, and by that means dissolve the tubes.

Microscopical Observations. Phil. Transf. N° 284. p. 1357.

THE contrivance of the ivory-box and hollow screw for approach, in Mr. *Wilson's* new set of microscopes, together with the illuminating convex at the extremity thereof, is of great service both by day and candle-light; as also the sliders, with the plain and concave glass-plates for objects, are very convenient; but the brass-tool wants improvement, and is capable thereof; *viz.* a fine threaded steel-screw for a more steady approach, and some new turns and motions to the arm which carries the object, &c. also a brass-arm might be made to slide up and down on the square rod of the deep microscope, to which might be fix'd with a screw either the ivory-box, or the handle of the brass-tool, to be set by that means in a fixed position.





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position to any height, or inclination requir'd, which will be very necessary, when an illuminating glass is applied to either.

As for the glasses themselves, they are very good and well wrought, and are far superior to any of *Mellins*; especially, the greatest magnifiers magnify more, and at the same time shew an object more distinctly than his do; the greatest magnifier shews to any eye a hair of the head considerably above an inch in diameter, and some eyes see it at least two inches; but, supposing it a bare inch, and that (as *Dr. Hook* affirms) 640 hairs breadth make an inch; the length and breadth of an object will, by this magnifier be enlarged 640 times, the surface 409,600 times, and the solidity 262,144,000 times: But the best of our glasses must needs fall short in power and goodness of *M. Leewenboeck's*; and tho' several people question the truth of his relations, yet this gentleman affirms, that as far as he was able to follow him (and he tried several of *M. Leewenboeck's* experiments) he always found him faithful in matters of fact; and therefore, he does not question his veracity in other things.

This gentleman first tried *Mr. Wilson's* glasses, with a live louse; and in it he could plainly see the motion of the muscles, when it stirr'd its legs; all which are joined in an oblong dark spot in the middle of its breast, where all the tendons seem to unite; the like motion of the muscles is also visible in the head, when it moves its horns, as also in the several articulations of its legs; he also saw distinctly a great many various ramifications of arteries and veins, and the pulse regularly beating in several arteries; but, the most surprising sight is the peristaltic motion of the intestines, which is continued from the stomach thro' all the guts to the *Anus*; he also observed the like peristaltic motion in a flea, and in several sorts of small transparent maggots and caterpillars: This gentleman found that a mite was not so transparent as he expected; however, he plainly saw, that all the bristles on the body of one of them (which to a common single glass, and to the greatest magnifier of his three glassed microscope look'd like plain smooth hairs) were, when viewed with a large magnifier, all spicated, or bearded like the ear on the seed-head of some grass, somewhat resembling *Platè VII. Fig. A*; and every bristle on the whole body and legs, both long and short, had the like formation; yet all mites are not so, for of seven or eight he had inclosed together, he found but one whose bristles were of this make, in the rest the horns only were

spicated; whether they were of different species, or rather only of different sexes, he could not determine; but, they were all taken out of the same cheese at the same time, and were in other parts very like; their mouths open'd horizontally to the right and left, like that of a wasp; and after having been shut up together for some days, he found some dead, and the survivors preying on them, which gave him an opportunity of observing their manner of feeding, which was very remarkable; for, they thrust one mandible forwards, and drew the other backwards at the same time, and thus they do alternately, by which means they seem to grind their food: When you bring one of the greatest magnifiers to observe a mite, or the like minute animal, you must lay him on a thin *Muscovy* plate in one of the sliders, and cover him with a concave, taking good care not to crush the object between the plates in your approach.

This gentleman pulled off a handful of muscles, which stuck to a piece of a rock, cover'd by the sea every tide; in these he found, that the organs by which they fasten so firmly to a stone, that even a storm will not wash them off, were threads which proceeded from that part called the beard of the muscle, and which had on their extremity a flat spongy substance, that adhered only by imposition, and they are very well described and represented by M. *Leerwenhoeck*; he also viewed and examined the inhabitants of those little white shells, which stick like pustules on muscle-shells, as also on lobsters, oysters, stones, &c. M. *Leerwenhoeck*'s figure of one of those little animals extracted out of its shell, is very accurate; only, that in the 12 long branches growing from the head, the bristles are there represented coming out quite round on each joint of every branch; whereas, they grow only on the inside (all the hinder part being perfectly bare) and look not unlike a ruffled feather strip'd on one side; this gentleman could not guess at the use of these curious ramifications, unless they serve to draw in the animal's food, which cannot move out of its place; for, having kept them alive in sea-water, he saw them often put out those branches thro' the slit of the *Operculum*, which closes the top of the shell, and draw them in again; this shell naturalists call a *Balanus*, and class it with the *Concha anatifera*: He took one of these muscles out of the shell, and exposing it to the microscope on a thin plate of *Muscovy* glass, he held it to the light of a candle, and he saw in the thinner parts a vast number of veins and arteries, and the

the blood circulating in them more distinctly than ever he had seen it in any other animal; for he had this advantage in the observation, that the object lay always quiet, without changing place, and his plate was so thin, that he could bring to it what magnifiers he pleased, and look upon it without disturbance; for whereas, other animals will not easily be brought to lie still any considerable time, and will not live long when exposed to a microscope; this lay always in the same position, and the motion of the blood continued with little alteration for six or seven hours, and might have lasted much longer, only by keeping the object moistened with sea-water; he repeated the same experiment for two or three days with some of the remaining muscles, with little difference in the success: He espied a small worm running amongst some fruit, which he could perceive to have a great number of legs; it was not half an inch long, and its body was not thicker than a hog's bristle; this insect he put alive into a small tube, and he found it a perfect *Scolopendra*, whose body consisted of 60 incisures; at every one of which, there was a pair of legs, one on each side, and each leg had five articulations; on his head were two horns, each of 16 joints, and under it a pair of *Forcipes*, red, crooked, and pointed, like the talons of a hawk, and this gentleman often saw him open and shut them, and wipe his horns thro' them; these *Forcipes* are not unlike, and probably are for the same use as those on a spider's head; but they are hardly seen (because, generally kept close) in a live spider, but you may readily find them open, and in their perfect shape, in a spider's *Exuvie*, or cast-coat.

This gentleman found a small black flat tick, stick on his arm, and it had got its fore-part so far into the skin, that he had much a-do to separate it with the point of a needle, so as to preserve it entire and unhurt; he observed its trunk Fig. B, shaped not unlike the jagged *Proboscis* of the *Serra Piscis*; the fore-part *a* resembling the extremity of a broad-pointed sword, is clear and transparent, and has three teeth on each edge, below which there comes out another serrated part *bb*, on each side, almost at right angles; but when you view the back, this is partly hid by a thick horn *c* on the side of the head; one of the horns was broken off at *d*, and then it appeared as in the annex'd figure, which represents the fore-part of this tick; he afterwards examined the *Proboscis* of dog-ticks, to see if they had the like conformation; and he found their appearance as in Fig. B 2; the *Proboscis a* being covered in such a manner with the two thick horns *bb*, that the

the serrated edges could not be perceived; but, separating the horns with some difficulty, they appear'd in the position of Fig. B 3; and then he could plainly see eight teeth, or jaggs on each side, as here expressed; but the *Proboscis* of the dog-tick had not the additional serrated part, which is in the wood-tick; he could also perceive a tube, or canal, run thro' the *Proboscis*, and see some bubbles move up and down therein, which are also represented by *a* in this figure.

This gentleman found some of the *Animalcula* in pepper-water almost incredibly minute, which appeared even to his greatest magnifiers not so big as a mite does to the naked eye; and in the largest sort, he could plainly see the little feet (by which they perform such brisk motions), which he never could find before; he also discovered one sort of *Animalcula*, which were very slender long worms, wherewith his pepper-water was exceedingly replenish'd; they were all of the same thickness, but their length was various, some being twice, and some thrice as long as others; and at a medium, he judged the proportion of their length to their breadth to be at least as 50 to 1; even to the greatest magnifiers they appeared as shreds of horse-hair do to the naked eye, from a quarter to three quarters of an inch long; upon a modest computation, their thickness was not the 100th part of an hair's breadth; and consequently, if you imagine a hair of your head split into above 7800 equal fibres, each fibre would be as thick as one of these *Animalcula*; their motion is equable and slow, and generally they wave their bodies but little in their progression, tho' they sometimes make greater undulations; but what is more remarkable, they swim with the same facility both backwards and forwards; so that he could not distinguish at which extremity the head was; and he has seen the same worm go forwards with one extremity, and back again with the other extremity foremost above 20 times together; and sometimes they would, like leeches, fix one extremity on the glass plate, (on which the water was laid) and move the loose part of their bodies round about very oddly; these he calls capillary eels, which are represented by Fig. C, according to the several positions they appeared to a great magnifier to swim in. The powder of the *Fungus pulverulentus*, or puff-ball, is the minutest powder this gentleman ever saw; when crushed, it appears to the naked eye like a smoke, or vapour; and with a common microscope the particles cannot be distinguished; but, when viewed with the greatest magnifiers, each grain is visible and exactly similar, and appears a perfect spherule of

an orange-colour, somewhat transparent, whose axis is not above the 50th part of the diameter of a hair; so that a cubical vessel of an hair's breadth on each side, would contain 125,000 of them; this was the size of the powder of that *Fungus*, which is bigger than one's two fists put together; and he observed, in another puff-ball of the size of a small crab (which he takes to be a different species) that all the globules were darker, and that each had a little tail, or stalk, fix'd thereto; he at first imagined, that these tho' so minute, might be seeds, but he was soon undeceived, upon finding that the smut of blasted corn was composed of the like regular globules, and of the same size; his method of observing these and the like sorts of powder, was by breathing gently on a thin *Muscovy* plate, and then covering it deep with the powder, to blow it off again; for enough would adhere, and the particles would not lie in confusion: This gentleman found a grub, of which a great number adhered to nettle-leaves; it was an exceeding thin animal, had a sort of a covering all over its back, like a broad shield, under which he lay like a tortoise, and was all over beset and fringed round with spikes.

A buck being killed in rutting time, about the end of *September*, this gentleman took out one of the *Testes*, with the adjoining seminal vessels, and he found the *Vasa Deferentia* very turgid, and full of a milky fluid; after various methods of viewing this liquor, he saw the *Animalcula* in vast numbers, as plain as tadpoles appear to the naked eye, moving very briskly in several positions; the greatest difficulty, was to lay them thin enough before the microscope; for, when the matter is too thick, you see nothing distinctly, only a confused motion; and when it is spread thin, it dries directly, so that you must be very quick, else you lose your labour: He diluted some of the *Semen* with warm water, just so much as would change its colour a little; and by that means he could see them, even with small magnifiers, more distinct and separate; and then they kept their shapes for a long time, even till next day when put into a small tube, but they were without any motion; to his best glasses they appeared about the size, and in the positions represented by Fig. D.

In his observations of the *Animalcula* in waters, he found several of the same species in the different infusions, and even in waters that have been exposed, especially in *September*, any time without any particular mixture, such as are found in the cavity of a cabbage-leaf, or on the *Dipsacus*, &c. and he is
confi-

confident, that several of these are the same animals under different appearances; for he observed such a regular process in them, and constant uniformity in their appearance, that he is of opinion most of them are produced from the spawn of some invisible volatile parents, and generated like gnats, and several other sorts of flies, which are bred, and undergo various changes in the water, before they take wing; probably, some of them may originally be water insects, or fish *sui Generis*, and are small enough to be raised in spawn with the vapours, and to fall down again in rain, and grow and breed in water when kept; and this will seem less surprising; because this gentleman assures us, he has seen some fishes as small as cheese-mites, of different species, and admirably form'd; and which are of the crustaceous kind, shell'd with several joints, having very long horns, fringed tails, and a great many legs, like shrimps, curiously contriv'd; and that some of these carry their eggs, or spawn, under their tails, in one bag; another sort in two distinct bags, and some kinds on the fringes of their legs like lobsters.

The *Animalcula* in pepper-water, represented by Fig. E, are very common, and are described by M. *Leewenhoek*. This gentleman has seen the tails of some of them 9 or 10 times longer than their bodies (which are about $\frac{1}{3}$ of a hair's breadth) but generally they are 4 or 5 times as long; as they move, they will often twitch up the tail in the position as mark'd at *b*; and this spring is so strong, that when the tail is intangled (as it generally is) by the extremity, they bring back their whole bodies by the jerk and convolution of the tail, which quickly returns to its first straightness; to a good glass, the extremity of the tail seems to have a knob on it as in *a*, and the folding appears as in *b*; but upon examining the knob with one of the greatest magnifiers, he found it to be only a close spiral convolution, like the worm of a bottle-screw; and that the whole tail, when twitched up, was also a spiral; this appearance to the great magnifier, is represented by *c* and *d*; he has also seen them sometimes, as in *e*; and he has further observed, that when these lie still, they thrust out a fringed, or bearded tongue, which they can draw in again; and that a rapid stream runs constantly towards their fore-parts, as if they drew in water; but he rather supposes, that this current is occasioned by a nimble tremulous motion of some minute fins, or legs, which his glasses could not discover: Those *Animalcula* mark'd F, also abound in all the waters, and are the largest

largest of all; and he could see them in a good light and position (without any other assistance) with his naked eye, their length being about a hair's breadth; these have a very quick motion, and are perpetually beating about like a spaniel in the fields; and by their frequent turns and returns, sudden stops, and casting off, they seem to be always hunting for prey; their bodies are very thin; that which this gentleman takes to be the back, is much darker than the other side; and you shall see them frequently turn sometimes one side, and sometimes the other towards your eye, and many times you may see part of each; their edges are, as it were, fringed with a great number of very minute feet, which are most conspicuous about the head and hinder parts, where are also some bristles longer than the feet, which appear like a tail; *a* represents one of these with the back, and *b* one with the belly towards you; and in *c* and *d* it is represented, as it often appears in other positions; he put some short threads of his hair into their water to compare their magnitude by, and he saw that they could use their feet in running, as well as swimming; for, they would often stand on a hair, and go on it backwards and forwards from one extremity to the other, often stooping down, and bending into several postures; among these, there is generally another sort (but not above $\frac{1}{3}$ of their size) whose feet are also very visible; some of them are shap'd almost like a flounder, and others are rounder behind; for, by their motions and actions, he judged them to be the same animals; these also will stand, and run on a hair, or on any sediment in the water; they are represented by *ab*, Fig. G; he has likewise seen them double as at *c*, and so go forwards, like flies in *Coitu*; he at first took them to be a single animal of that shape, but afterwards, he often observed them both join and separate, and two of them following a third, sometimes the first, and sometimes the second laying hold of it, and driving off the other: The little feet of these *Animalcula* are most distinguishable, when the water is just evaporating; for, being then stranded, they cannot change their places; and at that time, you may see them move their feet nimbly, and distinguish them some little while after the water is evaporated.

This gentleman thought, that those he calls capillary cels, had been peculiar to pepper-water; but in *October*, he observed the same (tho' but few) in some standing water, which drain'd from a horse-dung-hill; this liquor was mum-colour'd, and the most pregnant of all he had ever seen; and it would

seem incredible, what a prodigious number of *Animalcula* of all sorts, he computed to be in a quantity of it as big as a pepper-corn; for, they appeared as thick as a swarm of bees, or ants on a hillock; so that he was obliged to dilute the water, to observe the particular sorts; here he found not only almost all the *Animalcula*, he had seen in the other infusions, but several sorts which he had never met with before; amongst them were in great numbers, such as are represented in Fig. H; their extreme parts appeared bright, and the middle dark, and seemed to be beset with bristles; their tails were pointed, with a long sprig at their extremity; their motion was slow, and wadling; there was also a great number of a kind of eels, which appeared most distinctly, when the water was almost evaporated, making brisk shoots, and having a wriggling motion; they were of different lengths, and about the thickness of what he calls capillary ells; some of them, together with some of the capillary eels amongst them, are represented in Fig. K, the better to judge of their proportions; he preserved some of this dung-hill-water by him seven or eight days; and he found the number of these little eels to decrease daily, till he could hardly find one therein, tho' they were as numerous as before in the water newly taken up; and on the contrary, he observ'd great numbers in the water he had preserved, which were very scarce in the fresh water; amongst these was one sort very singular in its shape and motions; its body was spherical, only pointed a little like a pear; and it seemed very pliable, like a bladder fill'd with water, in which was a vast number of dark particles in a confused agitation; their most remarkable motion was a revolving one; they would sometimes turn above 100 times in a minute, sometimes not half so fast the same way, and then stop, and turn the contrary way; and all this without moving a hair's breadth out of their places; they also would go forwards, turn and return, and fetch a large compass with several deviations; and in their progression they always kept (even in the shortest turns) their pointed extremity foremost, the revolving motion still continuing; when the water is evaporated, their skin breaks, and the inclosed liquor diffuses itself; their shapes are represented in Fig. L; and they are of various magnitudes: There is another sort, represented in Fig. M, in great numbers, which are near as long as the largest kind formerly mention'd; these have brisk motions, and are very active; and they have several feet in the fore parts, very visible; they will often contract, and again

again dilate themselves as they swim; but especially when the water is evaporated, they will shrink up into a globular figure, and then their feet stand out, which you may observe to move very nimbly a considerable time after; these also are of various sizes; *aa* shews them at their length, and *bb* when contracted; Fig. N represents another animal, not uncommon amongst the rest, which is as large as the former; and in its motion, which is very nimble, it always keeps its sharp extremity foremost; he observed some variety in these (tho' he takes them to be of the same species) some being clear, and curiously striated from the point to the thick extremity; others having only the fore-part clear, and the bottle dark, as is shewn at *a* and *b*; but he could not, by any glass, discover the organs by which they mov'd.

This gentleman found a curious mechanism in a small diving-insect, which inhabits standing waters; it is like a small fly, with a head like a house-cricket, but, instead of wings, it has two paddles on the shoulders, and on the extremity of the hinder legs, which are longer than the other four, instead of feet and claws there are perfect oars; he also observed, in two or three sorts of flies, that behind the eyes, on the top of the head, were placed three protuberances (in an equi-lateral triangle with the foremost point) with a black shining globe in each, like a ball in a socket; and they are disposed in such a manner, as if they were form'd to look backwards; they are perfectly smooth, and without those hemispherical divisions, visible in the *Cornea* of the eyes of the fly and beetle kinds, but appear more like those of a spider.

This gentleman tried several methods of killing the *Animacula* before-mentioned; as by mixing salts, spirits, and acids, &c. with their water; the least touch of which would immediately deprive them of motion and life; but he could never succeed in any experiment of recovering or reviving them, after the water was evaporated, by the addition of fresh water; tho' some have affirmed, they may be revived by that means, even an hour after; and others, that they will recover after the water is boiled; several of these he mentioned, burst when the water was evaporated; and tho' some keep their shapes a little while, yet they also alter in a few minutes, and he cannot imagine that they are recoverable.

*An Apostemation of the Lungs cured; by Dr. Wright.
Phil. Transf. N° 285. p. 1372.*

MRS. *Jane Terry* was about 18 years of age, of a fresh complexion, and pretty fleshy, when her relations apprehending she might have the small-pox, removed her to a nurse's house, where she had the distinct sort very kindly; her case proceeded so very well (as they imagin'd) that no physician was called to her, till they began to shew; only, that for some days before, she had a little difficulty in her breathing, which gradually increased, till she began to throw up some blood, which was about the seventh day from their first appearing, and was accompanied with these following circumstances; it had increased every day, for three days before the Dr. saw her, she cough'd and brought up a viscous phlegm, such as patients vomit, when their stomachs are very foul; only, that as mere phlegm is white, this was all as red as blood, not streak'd with blood, or having a mixture of white phlegm, but so deeply tinged, that it seem'd to be all blood; only, that it would not flow as blood does, when it is hot; nor would it coagulate as blood does, when it is cold, but hung from the basons when pour'd out, as vomited phlegm does; and herein it differ'd from all the bloody expectorations the Dr. ever saw, excepting one Mr. *Jones* at *Kensington*, who cough'd the like bloody-colour'd *Pituita*, but in a much less quantity; for, Mrs. *Terry* threw up, for some days, above a pint in 24 hours; and tho' a less, yet a considerable quantity afterwards; Mrs. *Terry's* had a very strong smell, but Mr. *Jones's* had none at all; after some weeks the patient recovered, regained her flesh, which had been wasted in her illness; her *Menses* returned, and she continued very well from *July* till near *Christmas*: In *January* the Dr. was carried to see her, when she gave the following account of herself; that about three weeks before *Christmas* she found herself a little short-winded, which increased daily, with a heaviness and weight in her left side; that she lay well on the left side, but when she turned to lie on her right, she felt, as if a weight fell from the left to the right side, which gave her a shortness of breath, and made her cough; thus it continued increasing till *Christmas*, when she began to raise a considerable quantity of strong stinking *Pus*; she said, she eat her victuals well enough all this time, and was not feverish; at first, she was under the care of another physician, who told her relations, it
was

was an ulcer in her lungs, which he believed incurable; upon which, they again committed her to Dr. *Wright's* care; when he saw her, which was towards the middle of *January*, she often threw up a considerable quantity of a stinking offensive *Pus*, which was as fluid as the *Pus* of other parts; her flesh was a little fallen, but without any fever; she eat and slept pretty well, and had her *Catamenia* regularly; the Dr. prescribed such medicines, as abated that purulent expectoration several times, and she often gave him hopes of her recovery, she continuing to have her *Menses* regularly, and being still free from a hectic fever; but upon every little cold, she again discharged that fetid *Pus* in a considerable quantity; she generally continued pretty free from coughing several hours together, till she perceived something of a fullness in her breast, which would oblige her to cough; and after she had once begun to discharge, she could not cease, till she had brought up two spoonfuls, or more, of that fetid *Pus*; and this she did chiefly in the morning, afternoon, and at night; the Dr. apprehended she had an abscess in the left lobe of her lungs, and made her lie upon the bed, with her head reaching to the chamber floor, leaning upon her left arm; in this posture, she could at any time, after a little coughing, set the *Pus* a running out at her mouth, till the whole was discharged; then she would get up, and seem to be well, till it was almost filled again.

In the beginning of *May*, Drs. *Torlesse* and *Pitts* seeing her lie in the posture Dr. *Wright* had described: This expectorating of stinking *Pus* made it so apparent, that there was an ulcer in her lungs, that it was resolved upon to make an apertion in her side, where it was apprehended the lungs adhered thereto; for that seemed unquestionable, from the posture of discharging the purulent matter, and from some little pain she felt in her side; about a week before Mr. *Cowper* was sent for to perform the operation, the *Pus* had again begun to increase, and she was taken with a chillness, after which her pulse became a little quicker, and when Mr. *Cowper* applied the caustic, she was a little feverish; this feverish state increased every day, and some days after a rash appeared, which lasted about 14 days before it was quite gone, and it left her in a hectic, with a redness in her cheeks towards evening, night sweats, a continual looseness, extreme wasting of her flesh, and at length a swelling in her legs, tho' she kept her bed; some little knots were felt betwixt the 7th and 8th rib,
which,

which, with other circumstances, made us conclude the adhesion was in that part; and we would have applied the caustic there, but that it would certainly have spread to the glands of her left breast, which made us lay it on between the sixth and seventh ribs, reckoning them upwards; Mr. Cowper took it off as soon as he could, and with his knife he gently pass'd thro' into the cavity of her *Thorax*, whence issu'd a bloody water, but no *Pus*; by bending his probe he found the adhesion reach'd to the lower edge of the seventh rib; and before the *Eschar* was separated, the *Pus* began to flow at every dressing, and so continu'd, gradually abating, till the ulcer was cur'd; during which, a part of the inside of that rib, above an inch long, exfoliated, and after that, another lesser piece of the outside of the rib; towards the latter end of the cure, the patient complain'd very much of a pain at the *Cartilago ensiformis*, which was so great, that she sometimes pluck'd out the hollow tent, which we suppos'd might be occasion'd by its pressing upon the nerve; during the first seven or eight days of her rash, she brought up very little if any of that *Pus*; nor did it discharge itself any other way than by the orifice; nor was there a collection of it in her breast, which made Dr. Wright apprehend, that the fever did so alter the state of her blood, as not to permit it to separate its impurities into the abscess: For six days before the fever began, the patient had her *Catamenia* very regularly; about *August* following she was cur'd, her side clos'd up, for she could not bear its being converted into an issue; by *October* she recovered her flesh, and her *Catamenia* return'd, which had ceased ever since *May*; and afterwards she became plump, fleshy, clear and fresh complexion'd, had little or no cough, no fetid or tabid expectoration, and seem'd to be perfectly cur'd, having taken no medicines for several months.

There are several circumstances in this case, on which Dr. Wright makes the following remarks; *viz.* that there was an ulcer in the lungs, and that it had admitted of a cure, contrary to the general opinion of physicians; that this ulcer did contain at least two spoonfuls, and must have been as large as a hen's egg; that this abscess arose from a collection of purulent matter, with an indiscernible if any fever at all; and so continu'd from *Christmas* to about the 10th of *May* following: The tender membranous or vesicular composition of the lungs seems to justify this opinion; that it is almost impossible for them to heal, when there is a considerable diminution thereof, the continual and indispensable necessity of their motion, very much hinder-

hindering the coalition of the *Vesiculæ*; several parts of the body afford a proper cement to unite and repair them, when hurt or diminished; carious and broken bones send forth a *Cal-lus*; when the skin is consum'd by ulcers or burnings, the parts afford a *Cicatrix*, which supplies pretty well the defect of the skin; the lungs separate a viscid *Pituita*, which will be expanded into fleaks, like a membrane; Mr. *Stringer*, *Sarah Deeping*, and some other patients have brought up great quantities of them; and a little boy at *Kensington* cough'd up several pipes, form'd exactly like the *Bronchia* and its divarications; and at first view it seem'd to be the internal membrane; this child two years before, had an ulcer on the right side of his lungs, and they adher'd to his back; when Dr. *Wright* separated them he found a *Cicatrix* near three inches long, but very little, if any defect at all in his lungs; so that the Dr. is of opinion, that this *Pituita* or *Mucus* serves to re-unite the parts of the lungs, when there is a solution by an ulcer: Consumptive persons generally flatter themselves, that they have no ulcer in their lungs, because they do not feel a soreness, as in the ulcers of other parts; and this opinion keeps them from making a timely application to physicians, whilst they might receive a speedy and easy cure; when Mr. *Cowper* touch'd the sound or ulcerated parts of Mrs. *Terry's* lungs, with his probe or finger, she discover'd no sense of feeling, which may confirm the opinion of physicians and anatomists, that the lungs have little if any sensation at all; but when he touch'd her heart with his finger, tho' not the 20th part of a minute, she became very much disorder'd, pale and ready to faint, which shews that nature cannot suffer the least alteration in its pulsation, without great prejudice and inconveniency.

It is the opinion of some physicians, that the fever which attends consumptive patients, arises from some particles of the *Pus*, which being receiv'd into the blood, and circulating therewith cause that effervescence we call an hectic; this patient had no fever from *Christmas* to *May*; and then there came a continu'd fever with a rash, which left her feverish every afternoon, together with those symptoms which attend a hectic: Dr. *Wright* observ'd for several years, that could he but preserve his consumptive patients from that hectic fever, or relieve them who already labour'd under it, he could cure them, tho' their expectoration was very plentiful and foul: The Dr. does not doubt but some part of Mrs. *Terry's* lungs adher'd to her side, and it is probable, that a little portion of them did not receive the air in inspiration; but he believes, that defect was very inconsiderable, because

because she could run up stairs, and was no more disorder'd in her breathing, than most other people are; the easy discharge of the *Pus*, by her lying down in that posture, did undoubtedly very much preserve her lungs, and prevented its breaking thro' the abscess into the cavity of the *Thorax*, and putrifying her lungs to a greater degree; *Pus generat Pus* is a noted aphorism, and the air-bladders of the lungs are so very tender, that they must have yielded to the pressure of the *Pus*, had it lain long in the abscess, been only discharg'd by violent coughing, and by lying in a proper position; Sir *Thomas Proby*, *Sarah Deeping*, and others, have prevented a greater solution in their lungs, and either prolong'd their lives several years, or recover'd their healths by proper medicines; this and other instances, make the Dr. easily concur with some physicians in an opinion, that the lungs in some families have originally a more tender constitution, than in others; Mrs. *Terry's* aunts were subject to great coughs and the phthysick; her aunt *Fowkes's* little daughter of about seven years old, having a slight fever, with some symptoms of the small-pox, but a great difficulty in breathing; the Dr. advis'd bleeding, but she was so fat that no vein could be found; next day the small-pox appear'd, which eas'd her lungs a little, on the sixth night after, she brought up at several times about seven or eight ounces of clear blood, by violent coughing; the Dr. being sent for, he drew away about six ounces of blood, by leeches, which entirely reliev'd her breathing, and stopp'd her vomiting of blood; this instance being so like Mrs. *Terry's*, confirms what the Dr. said before, that so great a loss of blood will not hinder the regular proceeding of the small pox, which she went thro' very regularly and recover'd perfectly; the Dr. has observ'd the same effect in other patients, in whom bleeding after eruption was indispensable: The continual motion of Mrs. *Terry's Thorax* in breathing, made the caustic spread farther than it was design'd, or could be prevented; therefore the Dr. prevail'd with some patients to yield to an apertion by lancet, which in some cases, he takes to be the better method; that little quantity of blood which may possibly get into the cavity of the *Thorax*, is easily thrown out again by the lungs in inspiration; as Mrs. *Terry* did the injection every time Mr. *Cowper* us'd it: After that the *Pus* began to flow at the orifice, it lessen'd the discharge at her mouth, and in a short time, the purulent expectoration totally ceas'd.

The Same Case; by Mr. William Cowper. Phil. Trans.
N^o 285. p. 1386.

THE matter or *Pus*, which first flow'd from Mrs. *Terry's* side, was of so offensive a stench, that the by-standers were oblig'd to quit the chamber; and the nurse, usually at the time of dressing, and afterwards, was wont to burn rosemary, &c. to suppress it; so putrid was the *Pus* that it tarnish'd that extremity of the silver probe Mr. *Cowper* pass'd into the cavity of the abscess, as it did the top of a silver syringe in making injections; there seems no room to doubt that the *Pus* which then flow'd from the patient's side, came from the same cavity the *Pus* did she before cough'd up, when the liquor which was injected thro' the intercostals came into her mouth, which she frequently complain'd of; and particularly, of the bitterish taste of the tincture of myrrh Mr. *Cowper* sometimes us'd in the injections.

Amongst the various disorders that affect the parts of human bodies, those of the lungs have been look'd on as none of the least dangerous; and indeed, if observations did not assure us of the possibility of success, the commonly known structure of the lungs would afford us, but mean arguments for the shift nature makes, in the instance Dr. *Wright* has given a description of, as well as some other instances of the like nature Mr. *Cowper* had met with: A boy in the ninth or tenth year of his age, had for some time after a continued fever, been attack'd with an intermitting one; a cough ensu'd, in which he brought up at short intervals, no small quantity of thick purulent stinking matter, which discharge continu'd on him no less than 14 or 15 months before Mr. *Cowper* saw him; his physicians ordering him issues in his back, he made them as usual; the patient had then a healthful aspect, his cheeks were florid, and he was very brisk and active; as he came from play, he was bid take a basin in his hand, and cough as he was wont to do, which he did; wherein Mr. *Cowper* saw him discharge at his mouth no less than four or five ounces of the *Pus* abovemention'd; and this he had been wont to do twice every day; nor did he appear any ways disorder'd after it, but return'd to play immediately; his physicians sent the patient into the country from whence he came, where in about a twelve-month Mr. *Cowper* heard he died; what success the operation practis'd on Mrs. *Terry* would have had on this boy, Mr. *Cowper* cannot determine; tho' he was of opinion it might have been safely perform'd on him, and another patient

Mr. Cowper was afterwards call'd upon; but he could not obtain the consent of the physician that was consulted.

Another instance (in which a considerable part of the lungs was obstructed, and consequently became useless, some time before the patient died) was in a girl of 16, who had been scrophulous for nine years; the glands about her neck and throat being very much indurated as well as distended, her lips and nose were also swollen; about a year and a half before her death, she cough'd up seven or eight ounces of fetid Pus, in less than 24 hours; on changing the air of *London* for that of the country, together with the use of balsamic pectorals, she recover'd a healthful look in her face, but continu'd somewhat asthmatic; on taking cold, her appetite as well as digestion fail'd her, she became feverish and died after a few days indisposition; on opening the *Thorax* Mr. Cowper found the lungs adhering to the *Pleura* of the left side, in such a manner that they could not be separated without laceration; a portion of one of the left lobes of the lungs, being cut off, sunk in water, from which part it was likely the matter came, which she formerly cough'd up, tho' the ulcer was then clos'd, and no appearance of matter was to be seen in that or any other part of the lungs; the lymphatic glands, at the divarication of the wind-pipe, had by their intumescence so compress'd the canal of the left side, that it wanted more than two thirds of its proper passage for the air.

In these and some other instances, Mr. Cowper could produce, it is evident, that considerable parts of the lungs may be obstructed, and yet the person survive; but Mrs. Terry's case demonstrates the possibility of their recovery, when part of their lungs are totally obstructed, as must happen in such large abscesses; but how the remaining sound parts of such diseas'd lungs become capable of transmitting the whole mass of blood from the right ventricle of the heart to the left, in equal time and quantity with the blood that circulates in the rest of the parts, seems not so easy to account for: Mr. Cowper, having often found that water injected by the *Arteria Pulmonalis*, returns readily from the lungs again by the *Vena Pulmonalis*, tried if melted wax, when very hot, would not do the like; which accordingly succeeded in the lungs of two young cats; for after injecting the wax (mix'd with oil of turpentine, and tinged with vermillion) by the *Arteria Pulmonalis*, he found it had fill'd the pulmonary vein, together with the left auricle, insomuch that some of the wax had reach'd the left ventricle of the heart; some of the wax

was

was extravasated, and came into the *Bronchia* and wind-pipe at the same time.

In preparing a human heart, by filling its ventricles, auricles, and the trunks of its large blood-vessels with wax; Mr. *Cowper* found, on injecting the pulmonary arteries and veins with wax differently tinged, that the wax pass'd from the veins to the arteries, without coming into the *Bronchia*, or being extravasated, tho' the wax was not injected with near so much force as might be; and he could never make wax pass from the arteries to the veins in human bodies or quadrupeds, unless in their lungs, as above, and in the spleen and *Penis*; nor did it happen in those parts, but when the wax was impell'd with great force, tho' he constantly observ'd the communication of the arteries and veins of the spleen and *Penis* more open than in other parts, except in the lungs; it were to be wish'd Dr. *Morland* had told us in what part of the human body Dr. *Areskin* had made wax pass from the arteries to the veins, so as to demonstrate their continuation to the naked eye; because Mr. *Cowper* had hitherto found the naked eye unable to discover the extremities of the arteries and veins, when the blood itself was moving in them, in the transparent parts either of the *Omentum* or mesentery of quadrupeds, or in the lungs of live frogs or lizards; or after death, when the blood has been retain'd in their lungs in the following manner; on making an incision into the bodies of these animals, their lungs will start out, and be distended with inspir'd air; on these as quick as you can, pass a ligature, *i. e.* a wax'd thread, and tie it firmly towards the upper part of the lobe, as near the heart as possible; when the lungs of frogs and lizards are dried after being thus distended, examine them with Mr. *Wilson's* microscope described Phil. Transf. N^o 281, and they will appear as represented in Plate VII. Fig. first, third, fourth, fifth and sixth; the first and second figures shew the difference in the magnitude of the extremities of the veins and arteries of the lungs, and those of the foot of a frog view'd with the same microscope.

The manner of applying the dried lungs here mention'd is thus; take out the glasses in the slider, or flat piece of ivory mark'd in Fig. 4. *ee ff* of the said Transaction, and paste in the holes *ff* parts of the dried lungs, whether of frogs, toads, snakes, vipers, or the like animals, that have their lungs vesicated, as well as vesiculated; and by this means you may always keep by you objects of the lungs of those animals; only, you are to observe to place the external smooth surface of the lungs towards your object glass; when you view it in the same manner,

the extremities of the blood-vessels of any transparent parts of animal bodies may be examin'd by that microscope.

To return, hence it appears, that the communication between the arteries and veins of the lungs are more open than those of other parts, at least in the feet of frogs; and till it can be shewn, that melted wax can be as easily injected from the arteries into the veins of other parts in a human body, and in quadrupeds, Mr. Cowper is inclined to think, that the communications between the pulmonary arteries and veins in general are more patent, than the arteries and veins of other parts, excepting the spleen and *Penis*: This patent communication of the arteries with the veins of the lungs shews, how these vessels transmit the blood, in equal time and quantity with the blood that moves in the rest of the blood-vessels of the whole body in a healthful state; hence it is, that when any of the blood-vessels of the lungs are straitened or totally compress'd, the remaining unobstructed blood-vessels are forced to discharge more than they were wont to do, and in time these vessels become sufficiently dilated to supply the defect; the like happens in the communicant branches of the arteries of any part, when some considerable branch or trunk is tied up, as in the operation for curing the aneurism, *Phil. Trans.* N° 280.

Thus we find, that the structure of the parts of animal bodies is not only sufficient to perform the ordinary operations of nature, but their organs are so wonderfully contriv'd, that notwithstanding considerable parts of those organs are obstructed, yet their neighbouring parts (as the blood-vessels in the case before us) become capable of supplying the defect; and this indeed, excites our gratitude, as well as admiration of the divine architect.

Fig. 1. represents that part of the fifth figure at D. . . . done by a larger magnifying-glass, *i. e.* by the third glass of Mr. Wilson's microscope; A the arteries; B the veins of a frog's lungs, prepar'd as above-mention'd; C their inosculations with each other; D. . . . the area of the microscope, as it appears to the naked eye.

Fig. 2. part of the hinder foot of the young frog view'd when alive with the same microscope; whereby the different magnitude of the extremities of the arteries and veins of the lungs in the first figure, and in this represented at CC, is very evident; the former being capable of admitting at least three globules of blood to pass a-breast; whereas, the extremities of the arteries and veins in the feet only admit of one globule of the blood to pass before the other; A A the trunks of the arteries; B B those
of

of the veins lying by the side of the toes; CC their extremities continu'd with each other, in the transparent membrane between the frog's toes; *aa* two of the frog's toes,

Fig. 3. and 4. represent the extremities of the arteries and veins of a frog's lungs, view'd with the fourth glass of the said microscope; AA the arteries; BB the veins; CC their conjunctions with each other D... the area of the microscope.

Fig. 5. represents one of the hexagonal area's of a frog's lungs, which were not so much distended by inflation, as those parts of the lungs represented in the two former figures 3. and 4. whereby the little area's or cells in the interstices of the extremities of the veins and arteries appear closer, and less than in the two foregoing figures, tho' view'd with the same microscope; A the arteries; B the veins; D the area which is more magnified at Fig. 1.

Fig. 6. The lower part of one of the lobes of the lungs of a water-lizard, as it appears by the microscope, when the blood is retain'd in the extremities of the vessels, as in the preceeding figures; AA the trunk of the pulmonary artery; BB the vein; CC their branches joining with each other; DD the transparent smooth membrane, which in this animal is not vesiculated, or full of cells, as in the lungs of frogs, on which the blood-vessels are expanded; nor does the internal surface of this membrane differ from the external, as in frogs and divers amphibious animals; the lungs of these water-lizards being vesicated and not vesiculated.

Remarkable Curiosities in Denmark and Holland; by Dr. Oliver. Phil. Trans. N^o 285. p. 1400.

THE colleges and schools in *Copenhagen*, both as to their structure and foundations are very ordinary; the best the Dr. saw there was the donation of the learned *Borrichius*; consisting of 12 apartments for as many students, which are conveniently provided with stoves for their manner of living in that cold country; there is in it a small school for public exercises, and a little library belonging to their college; the rest of the students, excepting 100 maintain'd by the king in small colleges, live at lodgings in the city, as at *Leyden* and other universities abroad; who, when the *Swedes* threaten'd them with a bombardment in the year 1700, form'd themselves into a battallion, and did duty there, all the time the enemy was on the island of *Zealand*; there are in this university, which

which was erected about 200 years ago, about 1000 students, and sometimes they have had near 1500; the university-library, is in one large room over one of their churches, and consists of several libraries, the donation of particular persons which are kept a-part, with the benefactors names over them in capital letters; the royal library belonging to the king, consists of a great variety of books, in all languages, well condition'd and well chosen; the books of each country being plac'd by themselves; the room is large and well built, and has a large gallery supported by pillars on each side; if *Gudius's* library at *Gluckstadt* be added to this, as the Dr. was told it would, this library might be reckon'd amongst the first rank of the *European* libraries; the king's chambers of rarities are in all eight, large and well built, over the royal library; they are furnish'd with great variety of natural and artificial curiosities; the first contains coins and medals, both gold and silver, modern and antique, *Græcian*, *Roman*, *Danish* and *Oldenburgh*; besides those of other *European* nations kept separate by themselves, which altogether make a very valuable collection; amongst the natural curiosities, which are in the other chambers, the most remarkable are,

1. The petrified child, which is the same that *Bartholine* makes mention of in his *Hist. Anatom.* of which also *Paræus*, *Licetus de Monstris*, &c. give the history at large; this child was cut out of its mothers belly at *Sens* in *Champagne* Anno 1582, where it was suppos'd to have lain about 28 years; that it is a human *Fœtus*, and not artificial, is apparent to the eye; the upper part is of a gypseous nature, not so hard as the lower, the thighs and buttocks being as hard and as perfect stone as can be, of a red colour, and of a grain and superficies exactly resembling such stones as the Dr. has seen taken out of the bladder; he handled and felt it all over; it was first convey'd to *Paris*, and there it was bought by a goldsmith of *Venice*; of whom *Frederic* the III. king of *Denmark*, purchas'd it, and added it to his rarities.
2. Two elephants teeth, weighing 150 pounds a-piece.
3. Several heads of hares, with divers sorts of horns, brought out of *Saxony*.
4. An egg said to be laid by a woman, of the ordinary size of a pullet's egg; this, *Olaus Wormius* tells us, was sent him by very good hands, and confirm'd by people of credit; and he further tells us, that the woman brought forth two eggs, with the usual child-birth pains; the neighbours being call'd in to her assistance, they broke the first, and therein they found a yolk and a white,

a white, as in that of a hen; the second was preserved and sent to him; *Mus. Worm. p. 312; Jo. Rhod. Cent. 3. Obs. 57. 5.* The horn of a sea-unicorn, or *Monoceros*; so call'd because it is suppos'd to have but one horn, tho' sometimes more are found to grow out of the upper jaw; and the Dr. was credibly inform'd at *Copenhagen*, that one *Koens* a *Hamburger*, brought from *Greenland* the head of one of these with two horns thereon; the Dr. having carefully examin'd this horn (part of the head and upper jaw of the animal being brought home with it) he found it did not grow out of the middle, but from the left side of the upper jaw; so that it is probable there was a fellow to it, and then they may be said more properly to be his teeth or tusks, rather than his horns; whether this was only a *lusus nature* or not, or whether these animals naturally carry but one horn, as represented in the figures naturalists give us of them, the Dr. will not determine. 6. Several pieces of gold ore very rich, and some almost fine, dug out of the mines of *Norway* and *Hungary*. 7. Several large pieces of silver ore, likewise dug out of the mines of *Norway* Anno 1666; one of which weigh'd 560 pounds, was five foot six inches long, and four foot round, valu'd at 5000 crowns; from *Norway* there was also another piece, valued at 3272 crowns; Dr. *Oliver* observ'd a great many silver threads sprouting out of these two pieces, and he suppos'd that the whole mass had not above $\frac{1}{4}$ part of any baser metal, mineral or earth mixt with it; there are several of these silver ramifications, all from *Norway*, which he took to be virgin-silver and pure metal. 8. A great variety of very large pieces of amber; some dug out of the island of *Anaker* near *Copenhagen*, and others found when they were opening the ditches for the fortifications of *Copenhagen*; some of these weigh about 40 or 50 ounces, and were found every where sticking fast to pieces of black timber like ebony; whether amber be of the vegetable or mineral kingdom, would require a great deal of time to discuss; only that by the observations the Dr. made when he was in *Poland* and *Prussia*, where he saw great quantities every day fish'd out of the sea, as also dug out of the earth, he is inclin'd to the former opinion; nor can he conceive, how those animals that are found intomb'd in amber, being most of them, if not all inhabitants of the surface of the earth, should be caught in it, were it only a liquid when in the bowels of the earth. 9. A numerous collection of very large branches of coral, white and red, and one black. 10. A large pair of stag's

stag's horns growing out of a piece of wood, in a very surprising manner. 11. Another branch of a stag's horn, with a large piece of wood, naturally adhering to its top, which had pierc'd thro' the body of the wood, and grew some inches beyond it. 12. A sheep with a horn growing about an inch long out of its side. 13. The Dr. measur'd the thigh-bone of a human body, that was three foot and three inches long; the head was two foot and five inches round, and the middle 19 inches and a half about. 14. Two very large scallop-shells, weighing 224 pounds each. 15. A piece of marble, with a natural representation of a crucifix on its outside, highly valu'd by the *Lutherans*; and M. *Hartman* shew'd Dr. *Oliver* at *Koningsberg* in *Prussia*, a piece of whitish amber, that with a variety of colours on the superficies represented a woman with a child in her arms, which M. *Hartman* assur'd the Dr. was not artificial, and he kept it very religiously; there were besides these, a great many more natural rarities: Amongst artificial curiosities, Dr. *Oliver* observ'd;

1. A skeleton made of ivory in imitation of a human one, two foot and six inches long, so curiously and artificially put together, that one would take it for a natural skeleton.
2. Two crucifixes of ivory, with the whole history of our Saviour's passion, exceedingly well carv'd and express'd; besides he saw a great variety of toys made of ivory, curiously wrought on the outside; as a small man of war in ivory, with silver guns; several small galleys and sloops of the same materials, and one made of an unicorn's horn, with a gold anchor.
3. A watch made of ivory, with all its wheels and movements; several other utensils made of ivory, and a unicorn's horn, curiously carv'd and turn'd; besides some others of ebony, heart-oak, box, amber, silver, brass, &c. which are kept together for the curiosity of the workmanship.
4. In another chamber there was nothing but the garments, arms and utensils of *Indians*, *Turks*, *Greenlanders*, and other barbarous nations, in great number and variety.
5. A perspective of the late king of *Denmark's* family, the queen's face being in the middle, and eight princes and princesses round her, yet all conspire to form the king's face, thro' a hole of a glass-tube.
6. Six golden sepulchral urns, discover'd in the island of *Fuenen* Anno 1685 by a boor, as he was ploughing his land; when found, they were full of ashes or a greyish soil; the largest is two ounces and a half, the other five, about two ounces and one drachm; this confirms the accounts given

as by *Saxo Grammaticus*, *Olaus Wormius* and others, that it was a very ancient custom amongst the northern nations to burn their dead, and then bury their collected ashes in golden urns; they were very thin, and had three rings of gold round their necks, and several circles one within another, with one common center, carv'd on the outside round the body of the urn; they held between four and five ounces of liquids. 7. Another sepulchral urn of crystal, of a conical figure, found near *Bergen* in *Norway*, with a gold wire about it, weighing eight ounces. 8. The Dr. saw in another chamber several *Urne Lachrymales*, wherein were collected the tears of friends, which afterwards the old *Romans* mix'd with the ashes of the dead; some of these were of glass, and others of earth, and of different sizes; there were also brass lamps of several magnitudes and various shapes; some of other metals, others of earth, in the shape of animals or idols that were worshipped by the ancients; he also saw the *Stilus Æneus* of the *Romans*, the one extremity sharp to write with, and the other blunt, to erase what was written. 9. The large *Danish* horn of pure gold, weighing 102 ounces and a half, is two foot and nine inches long, and holds about two quarts *English* measure; this horn was accidentally discover'd *Anno* 1639 by a country girl, in the diocese of *Ripen* in *Jutland*; it is no doubt, some *Runic* piece of great antiquity, by the figures carv'd on the outside, which seem to be hieroglyphics, monstrous shapes of devils, hobgoblins, &c. and perhaps, some of these might represent their gods; and probably this horn was us'd in their sacrifices, as of old among the *Assyrians* and other ancient nations, who were wont upon solemn occasions to entertain the crowd with a great noise of horns and trumpets; or rather to drink out of, at their solemn entertainments. 10. The *Oldenburg* horn of pure silver, gilt with gold, and variously enamell'd with green and purple colours, weighing about four pounds; the *Danish* antiquaries tell us strange fabulous stories of this horn; which the Dr. omits, only observing, that whereas, amongst other things they say, that this horn was given to earl *Orho* of *Oldenburg* *Anno* 989, by the workmanship, it is plain it cannot be of that date; for the figures and characters engrav'd and imboss'd on its outside are modern; which with the enamelling and other ornaments, all curiously done, make it a very fine, as well as valuable curiosity; the Dr. found in the same chamber a great many horns of this kind, some in metal, others of bullock's horns tipp'd

with gold about the edges, and some of ivory, and unicorn's horns, &c. all prettily wrought on the outside with a great variety of emblematical fancies, according to the humours of those countries and times they were made in; and they were so many cups to drink out of at their solemn entertainments; and this of *Oldenburg* was finer than the rest, because designed for the royal table; it is said to have been made by command of *Christian* the first, who liv'd in the 15th century, in honour of the three kings of *Cullein*.

Dr. Oliver went one day a-shore on the island of *Weenen*, which the *English* sailors call *Scarlet Island*, from a tradition that queen *Elizabeth* had proffer'd for it as much scarlet cloth, as would cover it; this island is now an appendix to *Schonen* in *Sweden*, not above half a league from the main land; here the *Dr.* observ'd the ruins of *Tycho Brahe's* castle, which he had built on this island, given him by king *Frederick*, who supplied him with money for the carrying it on in the year 1567; this castle was built in the middle of the island, but is now demolish'd, and quite eras'd to the ground; and all the vaults and under-ground works are fill'd up, excepting the large observatory, which *Gassendus* tells us, in the life of this noble *Dane*, was distinguished from all the rest of his apartments under-ground, that were very numerous, by a solid round stone wall, part of which is still remaining; this was his great observatory, and was call'd by him *Stellæ-burgum*, or the city of the stars; as the castle was *Uraniburgum*, or the city of the heavens; the situation, no doubt was pleasant, it being on a very small eminence, in the middle of a plain island, not above three miles round; the same author tells us, that the king of *Denmark's* liberality was so great towards this learned man, that the best workmen were employ'd about it, and every thing well contriv'd both for pleasure and convenience, for instruments and astronomical observations, both above and under-ground, besides noble gardens, fish-ponds and a park; but by the fate of war between *Sweden* and *Denmark*, sometimes the one and sometimes the other being masters of this island, there is not one stone left of this magnificent structure; his instruments that were very fine, are now scatter'd up and down in *Germany*, and some few still remain in *Copenhagen*; the *Dr.* saw there in the *Roton* tower his own celestial globe, which was six foot and $\frac{1}{2}$ in diameter: This tower was built in 1601, for making astronomical observations, near the royal college in *Copenhagen*, and is above 150 foot high, whole

whose area on the top is 60 foot diameter; the passage up to it is large enough for two coaches, and the ascent so easy and hardly perceivable, that it serv'd for a place of parade for their gentry, when they had a mind to take the air in their coaches, riding up to the top, and so round the ring, as well as for an observatory; but M. *Romer* had converted the upper part of this tower to other uses, where in a dark room he had his instruments for observation; here the Dr. saw his machine for observing the stars by day; there is a pole 8 or 10 foot long, erected perpendicular in the centre of an equinoctial plane, on the top of which pole there is fastened a telescope, not much above three foot long, that reaches thro' the roof of the chamber, whose elevation is directed by an astronomical dial, upon the equinoctial plane, with an index fitted to it for that purpose, which determines it to the star he has a mind to observe at any time; he is likewise said to be the inventor of two other machines of great artifice and use; by the one he could shew at any time the station of any planet, according to the *Copernican* hypothesis; by the other he could demonstrate all the eclipses of the sun or moon, both past or to come: There is, besides all these, in the king's house in the garden at *Copenhagen*, a royal throne all of unicorn's horns, on which all the kings of *Denmark* are seated at their coronation.

In the year 1685, the Dr. was at *Koningsberg* in *Prussia*, where he saw the knife which was swallowed by a *Prussian* boor, who being sick one morning, thrust the hilt of his knife down his throat, in order to make him discharge what offended his stomach; but forcing the knife too far, it slip'd down his gullet into his stomach, from whence it was extracted by an incision on the left side, a little below the short ribs, with such success, that he lived several years after, in very good health; this happened in the year 1635; the operation was performed by Dr. *Daniel Swab*, and the knife is kept in a velvet bag in the King of *Prussia's* library; and measuring it by an *English* foot-rule, he found it to be but 6 inches and about $\frac{1}{4}$ long; the Dr. making an enquiry about it, was very well assured by several of the inhabitants that the matter of fact was true; and it is not likely, that the King of *Poland*, who was then at *Koningsberg*, the government of the city, and the college of physicians, who were consulted upon the operation, and were all eye-witnesses of it, would by printed certificates thereof contrive to impose a cheat upon the world; and one Mr. *Taylor*, a *Scotish* merchant in *Koningsberg*, told Dr. *Oliver*, that *Andrew Grunbeide*, for that was the boor's name, was his particular friend and acquaintance;

that he saw his wounds several times, when the surgeons dressed him, and was godfather to one or two of his children after his recovery.

When the Dr. was last in *Amsterdam*, he went to a tavern, where the master was very curious in birds, and had a great variety of uncommon ones; amongst which, he shewed him a cage with a bird in it, a little bigger than a capon, which he valued as a great rarity, and said it cost him near 100*l.* sterling; the Dr. owns he never saw a more beautiful animal in all his life, its body somewhat resembled a hawk, but its head and neck were bald like a vultur, only it had a few short feathers over its eyes, like eye-brows; its eyes were pretty large, and the iris was of a very fine bright pearl-colour; the feathers of this bird were curiously mix'd with a great variety of very beautiful colours; the bill and head were shaped more like the eagle than the vultur, tho' the Dr. took it to be of the latter kind, but of the smaller size; this bird was brought from *Carthagena* in *America*, and may be described thus; *Vultur Americanus minor Carthagena, corpore eleganti & plumis concinne admodum variegatis*; the Dr. presumes that this bird can hardly be of the same kind with those vulturs *Monardes* tells us of, in the islands near *Lima* in *Peru*, that prey'd on the cattle in the fields, if not carefully watched by their keepers: The Dr. did not see the cherry-stone in the King of *Denmark's* cabinet, which he was told, had some hundreds of heads engrav'd on the outside thereof; but once in *Holland*, *Anno* 1687, he was shewn by an *English* gentleman, a cherry-stone of this kind with 124 heads on the outside thereof, so that you might distinguish by the naked eye, popes, emperors, kings, and cardinals, by their crowns and mitres; it was bought in *Prussia*, where it was made, for 300*l.* sterling; whether this, or any other artificial curiosities of ivory, &c. before-mentioned, may compare with *Homer's* nut-shell; or the ivory-ants, and other little animals said to be made by *Callicrates*, whose parts were so very minute, that no body could see them, so as to distinguish the one from the other, but he who made them; or the ivory chariot made by *Mermecides*, which a fly covered with its wing, and a ship of the same hid under a bee's wing; and if, what *Pliny* and *Solinus* tells us, be true, whether the ancients have not out-done us in such kind of curiosities? The Dr. leaves it to others to determine.

A young Girl born Deaf and Dumb, taught to speak, with other Observations; by Mr. Charles Ellis. Phil. Trans. N° 286. p. 1415.

MR. Ellis having visited *Van Dalen* at *Haerlem*, he shew'd him, besides his own daughter, a young girl, born deaf and dumb, yet taught by Dr. *Amman* to speak very intelligibly; he heard her read *Dutch* and *Latin*; she was about seven years old.

Here Mr. Ellis was desirous to see the 1st book printed by *Costerus*; but he found it was not *Donatus*, as the *Inscriptiones Hollandicæ* say, nor *Virgil* or *Tully's* offices, as others have acquainted the world; but a *Dutch* piece of theology, printed only on one side of the paper; and after this is a single page of *Latin*, entitl'd *Liber Vitæ Alexandri Magni*, which made some take it to be *Q. Curtius*; but it is a monkish *Latin* of that time; this, and the theology, were printed in the year 1430; whereas the inscriptions, and some authors have told us from *Costerus's* picture, that printing was not invented by him till the year 1440; but a picture of *Costerus* before another *Dutch* piece, bound up in the same volume, and printed 1432, bears the date of 1430, under which picture is the inscription mentioned by Mr. Ray (only the date is ten years sooner) and the tetrastich, which was transcribed by the author of the inscriptions from an effigies of *Costerus*, which was then extant in a garden of this place, but it is not now to be found.

Mr. Ellis saw at *Amsterdam* a most curious physic garden, admirably furnished, and in excellent order; which, as containing more ground, and having more foreign plants, far exceeds that at *Leyden*. Here he also saw two female children, joined together from the neck to the navel; the *Viscera* in both were double and perfect, the head only was single, but common to both, and look'd over the right shoulder of one, and the left of the other.

At *Maestricht*, Mr. Ellis went into the quarry, which is larger than it has been described in one of the *Transactions*, being three hours in length, and one in breadth, and can shelter 100000 men; it cost Mr. Ellis a fit of an ague, thro' its excessive chillnets; the stone dug out of this quarry, is much like our *Kettering*; and the Jesuits have here a very fine chapel built of it.

Franciscus Linus's dials at *Liege*, the original of those formerly in our *Privy-Garden* at *London*, are much decayed, there remain-

remaining none of any use, but that which distinguishes the hour by feeling, and the globe which shews it in all other parts of the world.

At *Namur* there are no curiosities, but such as are military, excepting only the *Cachot* cut in the rock of the castle, with apartments for 600 men, and all rooms of conveniency, as kitchens, &c. which was done by the order of Marshal *Boufflers*, to defend the garrison from the bombs; and was the labour of four years: At *Liege* is Sir *John Mandevil's* tomb, whose epitaph is also at *St. Albans*, which may be difficult to be reconciled.

At *Brussels*, Mr. *Ellis* saw a young *Friesland* boy, of about five years of age, round the pupil of whose eye, they pretend, that there is naturally engraven *Deus meus*, and the same in *Hebrew*; this is look'd upon as a prodigious miracle in those parts; but, upon nicely surveying it, he could perceive, that it was only the iris of the eye, not join'd circularly, but lash'd out into *Fimbriae*, which here and there might be thought to form some imaginary letters; as beginning at the lachrymal corner of the left eye, there is something resembling D, I, and U, but not a vestige for the strongest fancy to work out any more; nor any letter of *Hebrew* in the right eye, as they pretended; Mr. *Ellis* does not doubt, but as the boy grows up, the others may conjoin again.

There are very few natural curiosities at the *Hague*; but there is an unparallel'd piece of art, which is performed by one *Elizabeth Pyberg*, who cuts in paper not only towns, as *Loo* and *Honousterdyke*, but also faces of an exceeding likeness; she did King *William* and Queen *Mary* better than any limner, and she refused 1000 gilders for the pieces; and Mr. *Ellis* could not think, but the Queen's drapery was point, (it was so very curious) till he had very carefully examined it.

Animalcula in Water, the Solution of Silver, &c. by M. Leewenhoeck. Phil. Trans. N° 386. p. 1430.

ABOUT the latter end of *July*, M. *Leewenhoeck* observing something that shone in the water, which gently flows by a canal thro' *Delft*, and which is very clear, and almost of the colour of the *Maese* water; he took a glass-tube of almost a foot length, and a finger's breadth, which he filled with this water, and viewing it with a microscope, he observed several sorts of *Animalcula* swimming therein, some of which he had never before met with; he viewed this water several times in one day, but he could not discover the shining matter which he had seen

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in the canal; on the 4th of *August* he renewed his observations, and then he could see in eight or ten places several small particles sticking so fast to the sides of the tube, that tho' he put the said water into a gentle motion, he could not remove them; whereupon, viewing the same with his microscope, he could plainly see those particles, representing a large bough, or branch of a tree, with a great number of sprigs about it; most of these branches were fastened with their stems to the sides of the tube, and seemed to arise out of a very small particle of matter that was fastened in like manner; that he might be further satisfied herein, M. *Leeuwenhoeck* took another tube, that was longer and broader than the first, and filled it with the same water, having first rinsed the tube once or twice; he viewed this water also several times, after it had stood 30 hours in the tube, and he again discovered the same sort of boughs, as complete and perfect as if you were to see the same with the naked eye on a tree; and amongst others, he observed one in such a position, as if the thick branches from whence the rest proceeded, lay just against his eye; he placed a microscope before this last particle, with a design to observe from time to time, whether it would increase in bigness; after the space of six hours, he could not find that it was grown any bigger; and he observed, that the extremities of the twigs, which were about 20, were laden with little transparent bubbles, whose diameters were twice as big as the said extremities; having now likewise observed about the twigs, a sort of transparent *Animalcula* of the same size with those bubbles; M. *Leeuwenhoeck* supposed, that the above-mentioned round bubbles were the same with those *Animalcula* that had taken their station on the extreme parts of the twigs; and he was confirmed in that opinion, by perceiving the next day in the morning, after that the water had been 48 hours in the glass-tube, that most of these round bubbles were got off the twigs, and that a very few of the *Animalcula* were upon them, and there remained immovable, whilst he made his observations; 12 hours after this, he could not see that the aforesaid branches were grown larger; but he then observed, that several of the small twigs were again invested with round bubbles, and an *Animalculum* that was about 50 times as big as one of the bubbles, was running upon one of the branches; and soasmuch, as the extremity of one of the twigs, where that *Animalculum* had been, was again laden with the said bubbles, he concluded, tho' he had no ocular proof thereof, that the said *Animalculum* had dropp'd her young ones there.

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On the 6th of *August*, he took another glass-tube of above a foot long, and an inch in diameter; one extremity of which was sealed hermetically, that there might be no cause of suspicion, that these branches or twigs proceeded from the cork; and having rinsed the tube two or three times, he set it on his desk, and viewed it several times, but he could perceive no branches, till after the water had stood above 40 hours in the tube; after which he took a microscope, and fastened it to the tube, to see whether the branches grew any larger, after the first discovery of them, but as nicely as he viewed them, he could perceive no alteration; now, he could see on the extreme parts of the said twigs three or four, or sometimes five round bubbles like roses, by one another; and when one of these branches (which was only fastened to the glass by its thickest extremity) came to be removed by that small motion, into which he put the water; all the five small twigs were likewise put into motion, and the same motion was also imparted to the bubbles, tho' some of their stalks were so exceeding minute, that he could not see how they were joined to the said twigs; he poured out the water very gently from the glass-tube, with an intention that the branches, which were fastened by their stems only to the sides of the glass (whilst their twigs were kept in a continual motion by the water) might lie along on the glass, in order to have them the better represented.

Plate VII. Fig. 7. A B C D E F shews the said particle, as it lies on the side of the tube; A the stem or root of the said branch, whereby it was fastened to the sides of the tube; here you may see what a vast number of branches and twigs there are in this single figure, which, indeed, appears irregular upon the paper; whereas, in the water, where they were unravell'd, and could play free, it was a very agreeable sight, being in colour like oak, and beset in several places with round bubbles, just as if they were composed of such particles; G and D represent some of the particles of the shape of a rose, which seem to consist of round bubbles, as also H, tho' their stalks were so fine, that he could not perceive them to be united to the main branch; however, when that moved, they moved also; as soon as the water was poured out of the glass-tube, he immediately viewed the said branch; and between two of the sprigs B D and B E, he saw two of the *Animalcula* swimming in the little water which remained unexhaled amongst the twigs, and their shape was like that of the bubbles represented by H; during his observations, he discovered an exceeding small particle, breaking off from one of

of the particles or bubbles under the said letter H, and presently it swam off with a little motion, but the whole space of its progress was not above a hair's breadth; the said small particle was certainly an *Animalculum*, for he could plainly see it turn and wind itself about; he also observed a little motion in another of these particles or bubbles, which resembled a rose, but it still remained entire; on the sides of the same tube, there lay several other small branches, but not so perfect as those represented in the 7th Fig. and when the water was poured out, they appeared like Fig. 8. I K L, and Fig. 9. M N O: It cannot be supposed that these boughs, or little trees, proceed from a seminal matter in the water, but rather, that they are composed of that matter, which ranging in small particles thro' the water, does by a kind of natural inclination unite, or coagulate, into one body; and this will not seem surprising to any person, who has seen the like experiment in filing of iron; for if you apply that part of the iron which you file, and which still remains warm, to the filings, it will immediately attract them, and they will hang down like a chain from the iron; nay, if you apply a magnet to these filings, the attraction will be much stronger.

M. *Leeuwenhoeck* did several times dissolve silver in *Aqua-fortis*, and as soon as he put it into the *Menstruum*, he always found a great number of air-bubbles arising from the silver, which before their separation from the metal, were as big as a common pin's head, or a grain of sand; these air-bubbles, as soon as they were separated from the silver, and in proportion as they mounted towards the superficies of the water, became smaller and smaller, insomuch that they almost escaped the naked eye, and presently after they vanished entirely; and this change happened, usually in the space of three pulsations; some of these air-bubbles lasted a little longer; others again, tho' as big as a pin's head, burst in pieces before M. *Leeuwenhoeck*'s eyes, without leaving any other smaller bubbles behind them; for his further satisfaction in this matter, he prepared a glass-bottle, whose axis was an inch and a half thick, of the shape delineated by Fig. 10. A B C D E F G; whereof A B C D represents the greater bowl or globe, and A D E G the smaller, and F the bore or orifice of the glass; M. *Leeuwenhoeck* placed this glass sloping, having first filled it, a little above E G, with *Aqua-fortis*, whilst it stood perpendicularly; and then he put into it two grains of fine silver, which lay at the bottom of the glass, in such proportion as is expressed in the said Fig. at B, whereby all the bubbles proceeding from the silver must ascend perpendicularly to C; being persuaded,

that when the quantity of air that was extracted from the silver would arrive at C, it would remain there; and that in proportion to the space the said bubbles possessed, so much of the *Aqua-fortis* would be protruded from the larger bowl to the smaller one; now, when he saw that but very few more bubbles arose from the silver, he could very plainly perceive, that most of those air-bubbles that had been extracted, did not only become less before they arrived at C, but were quite vanished; now that the silver was visibly united to the *Aqua-fortis*, and had remained so for 24 hours, there was as much air in the glass at C, as would fill the space of three or four pins heads; whereas, there arose such a vast number of air-bubbles from the silver during its solution, that M. *Leewenhoeck* was surprized what became of them, seeing they were in a manner vanished, without leaving any traces behind them; he made the air in C to dislodge by the orifice F, by raising the glass perpendicularly; and then upon throwing three times as much silver, a vast number of air-bubbles continually ascended towards C, but they were dissipated before they could arrive at the top; and such of them as were larger, and held out till they came to C, did then burst in pieces, without leaving any vestige behind them, excepting always as much air as would fill the space of three or four pins heads; further, he put 30 grains of silver into the said water, without observing any other remarkable difference, only that there remained at C, as much air in quantity as an ordinary pea.

In these his observations, M. *Leewenhoeck* did likewise take notice, that the larger the air-bubbles are, which arise from the silver, the faster they mount towards the top of the glass; and this also takes place, M. *Leewenhoeck* supposes, in what the learned call *Aer subtilis*; viz. how much the larger the particles of air be that perspire from our bodies, the faster they ascend; and so likewise in the descent of all heavy bodies towards the earth; as for instance, take two iron balls, one an inch in diameter, and the other five inches, and let these two iron balls fall at the same time from the same height; M. *Leewenhoeck*'s position is, that that ball, whose axis is five inches, must cut thro' a column of air 25 times greater than that thro' which the one inch ball passes; this being granted, he then says, that as those two columns of air, thro' which the iron balls must pass, are as 1 to 25; so the gravitation of both the said balls is as 1 to 125; now, that ball, which being 125 times heavier, and passes thro' a column of air that is but 25 times bigger than the other, must needs, he says, move quicker in its descent than the smaller ball; so consequently, must those particles (supposing them to be

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composed of the same matter) that are largest, perspire first and soonest thro' our bodies.

But to return; having first weaken'd some of this *Aqua-fortis*, thus impregnated with the silver, he put a little of it into a clean glass-tube, and now and then he threw into it a little copper of the bigness of a grain of sand; and then viewing the silver-water with a microscope, he observed that the silver in this clear water was coagulated into such bodies, as are represented by the above-mentioned trees, which coagulation we may call an inclination; and to give a better idea of this coagulation, there is represented a small particle of the silver, no bigger than a large grain of sand, in Fig. II. PQRST; M. *Leeuwenhoeck* was surprised to see, in a few seconds of time, such a coagulation of branched particles (which were invisible even thro' a good microscope) arising from a seeming clear, diaphanous, and liquid matter; now, what should occasion such a coagulation, insomuch, that no silver shall remain in the water, was to him entirely inexplicable: From these small coagulated silver particles, M. *Leeuwenhoeck* was led to consider the rich silver stone brought in small fragments from the *West-Indies*; whose particles are coagulated in just such branches as appeared by his microscope in the above-mentioned water; from whence, he was more fully confirmed in his hypothesis, that when the parts of that stone were a fluid substance, the silver particles were also mix'd therewith; and when the stone came to consolidate, the silver also coagulated in branches; just as we see it now lying in the stone, wherewith it is surrounded, and, as it were, imprisoned; from whence several have imagined, that in process of time the silver grew in the said stone.

M. *Leeuwenhoeck* took a piece of gold, and throwing it into a proportionable quantity of *Aqua regia*; in its solution he saw air-bubbles ascending in like manner, as in the silver; a little time after, he took some of the *Aqua regia* thus impregnated, and laid it on a clean glass, to observe, after the mingled salts were coagulated, what gold particles he could discover therein; when it was fair warm weather, the salts were for the most part coagulated, but in such a variety of figures, that they were hardly to be accounted for; sometimes representing an exact hexangular figure, and by and by the very same figures were no less irregular; the occasion of which was, as M. *Leeuwenhoeck* supposes, because, the coalescence of new particles was not equal on every side; but that which was the most remarkable was, that upon these salt particles, that were as transparent as yellow crystal, there lay other salt particles of a fine gold colour,

and sometimes they appeared to him, as if these fine gold colour'd salts were inclosed in the other salt particles; but when the weather grew damp and moist, all the crystal salts were dissolved, and the gold coloured salts were mix'd with the common particles; M. *Leewenboeck* took another little piece of gold, that had been wrought by a goldsmith, and having beaten it very thin, he put it into the same glass, where the other gold was with the *Aqua regia*; and he observed, that a white substance was separated therefrom and subsided to the bottom of the glass; for as *Aqua-fortis* dissolves silver, whilst gold escapes untouched, so *Aqua regia* dissolves gold, without affecting silver at all; from hence he infer'd, that that gold was alloyed with some silver, which was the white substance separated, as he said before; the piece of gold, that lay in the *Aqua regia*, would not unite therewith; whence he concluded, that there was too much gold and too little water, for he had made the glass so hot, that he could not handle it: Moreover, he took a small piece of copper, and putting it into *Aqua regia*, where a little gold had been already dissolved, he presently observed that the *Aqua regia* began to operate upon the copper, as if it had lain in *Aqua-fortis*; the gold also united with the copper, but in much smaller branches than silver in *Aqua-fortis*; and he saw, that the gold coagulated so strongly with the copper, that the water about the said copper was quite divested of its gold colour; and after an hour's time, the water was so impregnated with the particles of the copper, that it assumed a green colour, and then the gold that lay about the copper might be perceived by the naked eye.

Again, M. *Leewenboeck* took other *Aqua regia*, that was impregnated with so much gold, that it could dissolve no more; and he observed, that the coagulated salt particles were of an exceeding fine gold colour, being composed of extremely small particles, and the corners or angles were very regular; he plac'd those salts before his microscope, and they appeared of such a figure and texture, as if it had been a piece of gold newly taken out of the mines; now, in order to expose to view the coagulated salt particles in their first coalition, he put the said impregnated water on a clean glass, and then caused part thereof to run off the glass again, that the remainder might lie as thin as possible in the glass without touching it; M. *Leewenboeck* supposing, that by the said water lying thus thin, the salt particles might coagulate the more regularly; he observed afterwards, that most of those salt particles were hexangular, tho' so exceeding minute, that they almost escaped the naked eye; and several of them were regular

regular hexagons, as represented in Fig. 12. A, B, C; Fig. 13. D, E, F; Fig. 14. G, H, I; Fig. 15. K, L, M; and Fig. 16. N, O, P; most of these figures were as transparent as glass, and all of them were surrounded with a liquid matter, (somewhat of a gold colour) that did not exhale, tho' the weather was very warm and dry; moreover, he saw a vast number of particles so exceeding small, that their shape was not distinguishable, tho' he likewise took them for salt particles; the rather, because he could not observe any of these small salts lying near the aforesaid large ones, which, thro' the sympathetical inclination of homogeneous bodies, he concluded to be composed of a congeries of such small ones: He also saw other particles that were not pellucid at all, which he supposed were surrounded with so many gold particles, that they were not only of an irregular figure, but were also opaque; several of these salt figures were more protuberant in the circumference than in the middle, and had also several rings, which confirmed M. *Leeuwenhoek* still the more in his opinion, of the secret inclinations of homogeneous bodies; and thus in their increase, they preserve the same shape, which the single salts had put on at their first coagulation: M. *Leeuwenhoek* also put a little piece of copper into such water, and he observed, that immediately the gold had united itself partly with the copper, but the *Aqua regia* had not so much power over the copper, as to protrude out of its substance so many air-bubbles, as it might otherwise have done, had there not been so much gold therein; the water thereupon assum'd a greenish colour, and all the yellow colour was turned into coagulated gold, insomuch, that the gold might be distinguished from the copper by the naked eye; particularly, the extreme parts of the little boughs, which were formed by the coagulated gold; tho' the said gold consisted of particles so very minute, that they did not appear larger to a good microscope, than the smallest grains of sand do to the naked eye.

When M. *Leeuwenhoek* had weakened with rain-water the *Aqua regia*, which had been impregnated with a great deal of gold; and had then put into it a bit of copper he observed, that in a short time the gold was coagulated or united with the copper, and that the water was turned to a light green: He also observed, that the small twigs of these coagulated particles were not of a pure gold colour; from whence he infer'd, that there was copper blended therewith; the said *Aqua regia*, which had been impregnated with gold, having remained some days in the glass, he perceived, that where it was thickest, it was covered with a film

film or skin; and that most of the salts, when the weather was not warm, nor the sun shined, were dissolved, and much more in rainy weather: Moreover, M. *Leeuwenhoeck* exposed the glass with the said water to such a degree of the heat of the fire, that the salts evaporated in smoke, and that part of the glass where there lay least of the *Aqua regia*, assumed a colour that was somewhat upon the red; but where the said water lay thicker, he could not see the fine shining gold with the naked eye; but upon raising that glass, where the gold lay, higher to the light than the microscope, he saw that the gold particles were not united with the other, but now and then coagulated into branches; and where the gold particles were not thus coagulated, they were so very small, that how nicely soever he viewed them, they escaped his sight; and tho' there lay together more than 1,000,000,000 of these small particles, all of them did not make a body that was bigger than a single grain of large sand; where this matter lay thin and dispersed, he observed that its small particles were such solid and compact bodies, as did not admit the least ray of light; and where they lay single, he saw other particles still smaller, whose bodies were more loose, but M. *Leeuwenhoeck* supposed that these last were some particles of that matter, which the *Aqua regia* had left behind it: Now, after that the said *Aqua regia* had remained on some of the glasses several days, and the salt particles for the most part were changed into a fluid substance; he observed amongst several of the coagulated branches small distinct particles, which he supposed to be gold, tho' by reason of their minuteness, he could not perceive their colour; to satisfy himself herein, he took a small glass-bubble, with as much *Aqua regia* impregnated with gold, as was something bigger than a large pin's head; and he set it over such a strong fire, that both the glass and gold were ready to melt; and then viewing the glass, he saw very plainly, that a small portion of the said gold was coagulated into branches, and that these coagulated particles were round knobs or bubbles, which were dispersed in great numbers over the whole glass; in some places close together, in others thinner, of different sizes, and several of them so small, that tho' he viewed them thro' a good microscope, they in a manner escaped his observation; insomuch, that it is almost impossible to conceive, unless one has had ocular demonstration thereof, that such vast numbers of gold globules could proceed from so small a quantity of matter; and who knows how many more gold particles must coalesce in melting, to compose one of these minutest globules; now, tho' the small gold particles could

not

not be discover'd, when surrounded with *Aqua regia*, yet the shining gold colour of them all could be easily seen (excepting only the very minute globules) appearing like so many complete round pellets.

In winter, when those ditches, in which M. *Leewenhoek* had seen a deal of that green weed, called duck-weed were cover'd with ice, he saw but very little of it, and what he saw had a very small leaf; upon this, he thought it might be possible for those green weeds to spring from the earth in warm weather, tho' it did not seed upon the ground, nor increase in bigness there; for supposing, as it really happens, that these weeds in warm weather, by the rarefaction of the particles of air in their vessels are driven up to the surface of the water, the same weeds by the contraction of the air in cold weather will become heavier than the water, and consequently sink to the bottom; and according to the change of the weather, have their vicissitudes of emerging or subsiding: To be convinced of this rising and falling of the green weeds, take a small glass-bubble, such as that represented by Fig. 17. Q R S T, leaving the small orifice at T open for the water to run in and out at, and let this bubble be put into a vessel with water; and you shall find, that by the dilatation of the particles of air within the said bubble in summer, it will rise to the surface of the water; whereas the same air, thro' its elasticity, being contracted in cold weather, will make room for the admission of a mass of water so much heavier than itself into the said bubble, and then it will subside.

The Seeds of Oranges, &c. by the Same. Phil. Trans. N^o 287. p. 1461.

M. *Leewenhoek* had several times open'd the kernels of oranges and lemons; and he often found that what we call a stone, kernel or seed, is improperly so call'd; and that after stripping it of the skin or membrane, we shall frequently find that two seeds are inclos'd therein; to wit under the skin, and without side of the kernel there is a small seed, such as had not occur'd to him in other sorts of seed; it is true, that you shall often find in hazel-nuts, almonds, peach and apricot-kernels, a double seed, but then each of them is inclos'd in a separate membrane, having no communication with each other, but by a bare contact; whilst each has a distinct stalk or string, by which consequently they receive their proper nourishment.

In

In November, M. *Leeuwenhoek* had a present made him of *Surinam* oranges; in the first he open'd he found 38 complete kernels, but in neither of two others could he meet with four good seeds; he open'd several kernels of the first orange, one of which, inclos'd in its membrane, is represented by A B C D Plate VII. Fig. 18. after stripping one of these kernels of the outer membrane, he discover'd that there lay a string under it, that caus'd a little protuberance in the first skin represented in the said Fig. by A B C; from which string, not only the seed, but also the plant within it receiv'd its increase and nourishment; E F Fig. 19. shows the same seed separated from its first and hard membrane, which is only design'd, as M. *Leeuwenhoek* supposes, for the defence of the inward parts; whereas, nuts, almonds, peach-stones, &c. are arm'd with strong thick shells; F G represents the aforesaid string, which he separated a little from the seed itself, to render it the more visible; and it is not only join'd to the seed at F, but extends its small vessels also thro' the second membrane from F towards E the seat of the plant, thence to receive its nourishment; but those vessels are so exceeding fine and minute, that you lose sight of them before you can trace them to their origin; now we may certainly conclude, that the said string does actually comprehend in itself as many distinct vessels, as are to be found in the orange-tree when arriv'd at its full maturity; for if all these vessels were not in the young plant, whilst it lies involv'd in its mother's, viz. the kernel's *Matrix*, whence could they afterwards proceed? M. *Leeuwenhoek* succeeded several times, but not without a great deal of trouble, in discovering the vessels within the said string; Fig. 20. H I K L M N represents a part of the same string cut a-cross, which Fig. 19. F G shews entire, and in its whole length; the said part of the string at H I M N has abundance of exceeding small vessels, but very hard to be seen; about I K L M they grow larger, and consequently are more visible; and thus you may see a great many, tho' not all the vessels; after he had made this observation, he bethought himself, whether these great vessels were not the origin of the contexture of that membrane, which covers the seed; and on the other side, whether the former represented by H I M N did not feed the seed and plant.

Fig. 21. O P Q represents a piece of another string of an orange kernel cut a-cross plac'd before another microscope; R S T V that part of the hard membrane that surrounds it; T

V. Q. W

V Q W faintly shews, that vast number of fibres, particularly at Q W, which nature uses in the contexture of such a small string, which made M. *Leeuwenhoeck* suppose, that those long fibres represented by Q W were design'd to add a stiffness and solidity to the outward membrane, for the better defence of the internal vessels; he often observ'd, that the outmost membrane R S T V did compress the string so closely, that there remain'd but little space between them; in the same Fig. X Y Z represents that membrane, which surrounds the kernel or seed and the plant; and all the membranes are very thin, particularly the innermost of them; upon cutting such a seed or kernel a-cross, one would take the particles of which it is compos'd, to be nothing but irregular globules squeez'd or compress'd close together.

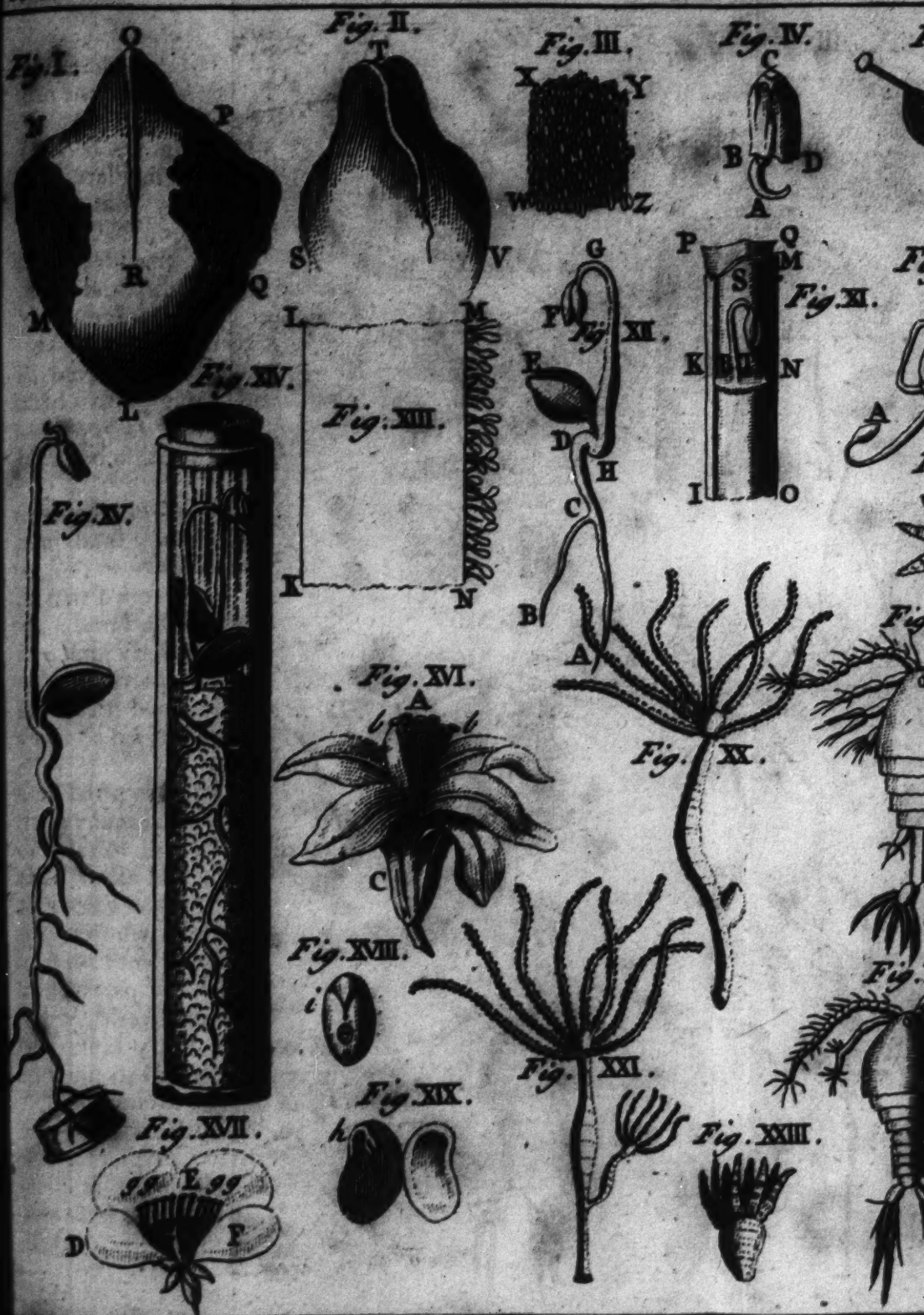
Fig. 22. A B represents such a seed divested of its membrane, and which seem'd to have but one plant within it; whereas, he has often seen under the membranes another small plant, which lay as if it was squeez'd into the substance of the seed, and so is not to be seen till the seed is stripp'd of its membranes, contrary to what M. *Leeuwenhoeck* has before hinted, concerning nuts, peaches, almonds, &c. which, where there is a double seed, lie entire and distinct in their proper membranes; he has likewise observ'd under the membrane of an orange-kernel three distinct seeds with their plants, whereof some indeed, were larger than the others; these seeds with their inclos'd plants are easily divided into two lobes or distinct parts, insomuch that they do not seem to have been united, but only where the small plant lies; so that the whole kernel A B was fram'd by nature for no other use, as he supposes, but to nourish the tender plant within, till it is able to stand alone, and draw its subsistence from the earth about it; having split the seed A B into two parts, one of which is represented by Fig. 23. C D E F, together with part of the plant, which would have become a tree sticking close to it, you may see the plant itself at C, no bigger than a grain of sand to the naked eye; the counterpart of the aforesaid kernel is represented by Fig. 24. G H I K, and G the little pit or bed of the plant; and in the said figure between H and K the concavity wherein the second seed also lay, as likewise between D and F Fig. 23: This sight was wholly new to M. *Leeuwenhoeck*, tho' he had dissected several sorts of seed before; viz. to see in the middle of one seed or kernel another complete and perfect seed; especially when he consider'd that from the vessels, arising from

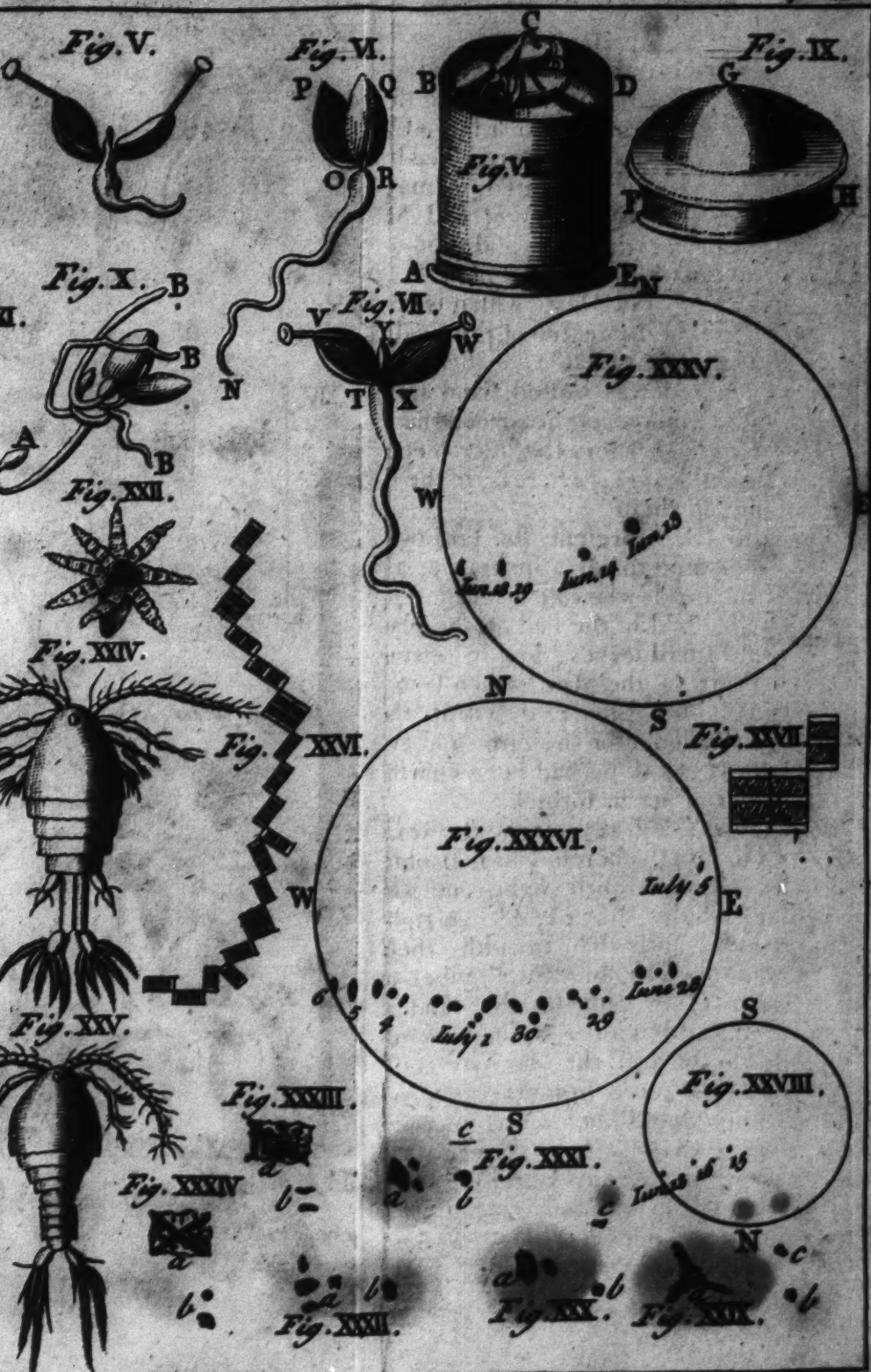
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the string, and dispersing themselves thro' the membranes, both the kernel and plant are produced; and yet the same vessels must insinuate themselves into the very heart of the first seed, before they can produce a second lodged within it; placing such a small plant as is represented by C in Fig. 23. before a microscope, he had it delineated, as may be seen in Plate VIII. Fig. 1. LMNOPQ; whereof QLM is partly that which nature intends for the body and root of the tree; NOP the leaves, wherewith the young plant is already provided; and OP is that part of the leaf, which is next the sight, and somewhat protuberant, by reason of the smaller inclos'd leaves; MN and PQ shew the two sides of the plant torn off from the kernel, to which it was united, and from which it received its nourishment; moreover, he turned the said young plant a little about, as it stood before the microscope, in order to represent the two largest leaves; whereas, in the former position he could see but one of them.

Fig. 2. STV represents the said two large leaves; between which, according to all appearance, a great many small ones are shut up; and when he came to cut the leaves a-cross, as they lay involv'd in the bed of the plant, he imagin'd that he saw the said small leaves; and in cutting, after the same manner that part of the plant which is to be the body and root of the tree, he discover'd within the small particle, that which was design'd for the pith, and even the wood itself, and all as plainly, as if he had been viewing with his naked eye a young plant of an inch thick.

Fig. 3. WXYZ represents the texture of the pith, as it appear'd to him; wherein you may observe a great many small particles, which at first sight, one would be apt to take for irregular globules, but placed in a right line, and all of them of a greater length than breadth; these M. *Leeuwenhoeck* took to be nothing else but small tubes or vessels, whereby the plant receives its nourishment, and perhaps, every one of them is cover'd with a distinct membrane; the parts which compose the pith of the plant are not to be discover'd, unless you cut off a piece from the seed with a sharp knife, and place it immediately before the microscope; for all its moisture is so soon exhal'd, after it is cut, that one cannot possibly make any observation; moreover, on the 19th of November about seven o'clock in the evening for further satisfaction, he took a little copper-box, into which he put some scouring white sand, which was very dry, only that it was somewhat moist.





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moisten'd by the seeds newly taken out of an orange, which he mixed therewith; afterwards, he carried the box in the day time in his fob, and all night he placed it within a large tin bottle fill'd with hot water, by which means the little box was kept warm till the morning; and after repeating this for three days following, he open'd the box, and took out one of the seeds, but could not discover any change therein; on the 25th of *November* about six o'clock in the evening, after that the sand and seeds had been kept six days in a continual warmth, he open'd the box again, and he observ'd that the root was shot forth a small matter out of the membranes of the seed, as may be seen in Fig. 4; A B being that part of the plant, which was to become the root; and B C D the rest of the seed involv'd in its membranes; moreover, he took another seed out of the said box, which having cleans'd from the sand, and separated from its membranes, he took the two lobes of the kernel that inclose the plant, as in Fig. 23 and 24, and with fine pins he parted them a little asunder, to shew the top of the plant represented in Plate VII. Fig. 25. O P Q.

Fig. 5. E F G H I represents the seed, which had lain six days in the sand, and was divested of its membranes; E F shews that part which is destin'd for the root; F G and I F are those parts, from which the young plant receives its nourishment; and which by two pins K and L are divided from each other, to discover that part of the inclos'd plant, which will become the body of the tree, which is represented by H, and may be observ'd with the naked eye.

Fig. 6. N O P Q R shews how far the seed can shoot out its root in 12 days, which is also divested of its membranes, and placed sideways before the glass, that the strings, whereby the two parts of the seed are united to the plant, may be the more easily discover'd; N O R shews the root; O P and Q R the seed or kernel divided into two equal parts; O R the strings united to the plant, from which it draws its first nourishment; upon cutting those strings a-cross and close to the plant, he found in each string three vessels, thro' which he concluded, that most of the nourishment was deriv'd from the seed to the plant; he separated the two parts of the seed with two pins, that they might be the better view'd by the naked eye, as may be seen in Fig. 7. where S T X shews the root; T V and W X the two halves of the kernel, and Y that part which is to become the body of the tree, much larger than H Fig. 5.

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After M. *Leeuwenhoeck* had proceeded with his copper-box, about 18 days, in the manner above-mention'd, he open'd the same which is represented by Fig. 8. A B C D E; C the seeds and plants as sprung above the surface of the sand. Fig. 9. F G H shews the cover of the said box, out of which having pour'd all the sand, he observ'd that all the moisture was evaporated from it, which doubtless was extracted by the seeds, of which he had put 16 into the said box; and all of them shot out their roots and produced plants, some of which were bigger than the rest; and two or three of the seeds produced double plants; and amongst them was one that yielded three plants.

Fig. 10. A A A represents the said three plants; and B B B the three roots; both which were confus'd and jumbled together; which he attributed to the pressure, and too great nearness of the other seeds; when M. *Leeuwenhoeck* observ'd how dry the sand was, which he had pour'd out of the box, he suppos'd, that if he had put a little more water into the sand, or fewer seeds, there would have been a greater increase both of the plants and roots; therefore he took a glass-tube, that was large enough to hold the sand conveniently, and hermetically seal'd at one end, and about twice as long as is here represented in Fig. 11. I K L M N O; in this tube he put five or six seeds, and he laid between each of them a little wet sand, which was very fine and white, and of that sort which is us'd for the making of glass, which he had always kept dry for above 12 years; he proceeded with this tube, as he had done before with his copper-box, having stopp'd it with a piece of cork as in L P Q M: On the 10th day he observed, that the seed was come to such maturity, that the part which nature intends for the body of the tree, was grown up as high as the cork; and upon the 12th day it appear'd, as represented in the said Fig. R S T; having done this, he took the plant out of the glass-tube, which is represented in Fig. 12. A B C D E F G H; only observe, that this plant had but one root A C D H; but because others had more roots, they are represented by B C; here F G shews that part which is to be the tree; D E the seed or kernel, which being surrounded with its membrane, he took off, the better to expose to view those parts that serve for the nourishment not only of the root, but of the upper parts of the plant likewise, as also the short string D.

Fig. 13. K L M N shews a small part of the great root; it appeared as thick and as large as the space between K and N; and

and the small roots appeared growing out of the sides of the large root, as is represented between M and N: Thus we may see with the naked eye, how a small particle no bigger than a coarse grain of sand (as the plant is represented by C Pl. VII. Fig. 23.) is increas'd in bulk, within the space of 11 days, as has been already shewn in Fig. 12. A H G F; and all this is brought about by heat and moisture in a close vessel; which is a plain demonstration, that the plant and all that belonged to it was actually in the seed; that is to say, not only the young plant; its body, root and fruit, but even its seeds also, to perpetuate the species.

In December he took another glass tube longer and larger than the first, as Fig. 14. A B C D E F G H, which he stopp'd at both ends with a piece of cork, boring a little hole in the upper cork, he filled the tube a little higher than B G with dry scouring sand, which he first moisten'd with a little rain water; only you are to observe, not to make the sand too moist, because the seeds will rot; nor too closely compress it, lest it should hinder the young plant from pushing forth its root or branches; in the upper part of this sand thus dispos'd, M. *Leewenhoeck* set two kernels of an orange brought from *Curacao*, some days after they had been taken out of the said orange; and being drier than the others, they consequently requir'd a longer time before they could sprout out; but in the space of three weeks, by the warmth of his body only, they germinated, as is represented in the said Fig. by B C F G; and pouring out some of the sand, wherewith the seeds were cover'd, they appear'd as in B C G; between A B G H are represented the long roots with their small twigs and branches against the sides of the tube: Afterwards M. *Leewenhoeck* had observ'd but very little change in the plant for some days; the reason of which, he suppos'd to be, that all the moisture was exhausted by the plant; wherefore, pouring a little more rain-water upon the sand, the plant grew bigger; insomuch, that in five weeks time it was got almost to the uppermost cork D E; and the roots also were spread into more branches, and had not only extended themselves to the lower cork; but one little root had insinuated itself between the cork and the glass, and had there shot forth another branch; whereas, the external membranes of these seeds are very thick and hard, and that part of the tender plant, which nature has design'd for the tree is not able to perforate or burst it asunder, as happens in the plants of nuts, almonds, peaches, &c. therefore this

this plant does not spring up in a right line thro' the seed or kernel, but out of its sides, as may be seen in Fig. 12. between D and F, and in Fig. 15. between N and O.

After that one of these seeds had lain near six weeks, shut up in the glass-tube, and grown in proportion to that time; M. *Leerwenhoeck* observ'd, that one of its leaves was withered or corrupted; whereupon, opening both the corks, and pouring out the sand, which being very dry came easily away, a small shoot of the root had so insinuated itself into the cork, that he could not separate them without some violence.

Fig. 15. I K L M N O P represents the said whole plant, whereof L M N shews the body; M the three leaves it had put forth a-top; I K L the root, with its twigs and shoots; L N O the seed, or kernel, still surrounded with its membranes; and lastly, I P shews the cork that stopp'd the bottom of the tube, together with the root sticking thereto.

Now, if we renew the comparison (which M. *Leerwenhoeck* formerly made) between the *Animalcula in Semine masculino*, and these plants; tho' these *Animalcula* are 1,000,000 times smaller than a plant in an orange-kernel; and tho' we cannot make our observations of the growth and increase of the said *Animalcula*, from time to time, in their mother's matrix; yet, we may certainly conclude, that the laws which the wise creator of all things has prescribed to himself, in the production both of animate and inanimate creatures, are homogeneous and uniform; and that as the earth is the common *Matrix* of plants, so is the *Tuba Fallopiana* in most of those animals that are formed *ex Semine masculino*; for, as the animals in the *Matrix* receive their nourishment and increase by a string, till they are brought into the world, so are all seeds (at least, as far as we know) supported and nourished by a like string; and the seeds thrown into the ground do again, by the same string, whereby they received their increase, convey nourishment to the seed or kernel.

M. *Leerwenhoeck* had discovered, that there are some *Animalcula* which have no males amongst them; and the same is also observable amongst a few species of fish; these *Animalcula* and fishes may be compared to some seeds, which have no other substance in them, besides the plant itself, and the membranes that envelope it; such are the seeds of the beech-tree, as also those of cresses; M. *Leerwenhoeck* also discovered the strings of the walnut and chesnut-seeds, whereby nourishment, &c. is derived to them.

Now,

Now, since M. *Leeuwenhoeck* could, with a little sand and water shut up in a copper-box or glass-tube, and a moderate heat, bring certain seeds to maturity, which in our climate are of a long and tedious growth; he from thence concludes, that he knows no other secret in vegetation, but a complete heat of the sun, and a just quantity of water; nay, he does not stick to say, that the increase and nourishment of all plants is included in water; for, let the barren and unfruitful downs in *Holland*, that consist of a very fine sand, be brought to such a level, that they lie but a foot higher than the moats and ditches round them, so that the rain-water does not drain away as it falls, such land will not only produce good grass, but even rye, barley, and several other sorts of grain.

Observations upon the Parts and Use of the Flower in Plants;
by Mr. Samuel Morland. Phil. Trans. N^o 287. p. 1474.

IT has been long ago observed, that there is in every particular seed, a seminal plant conveniently lodged between the two lobes, which constitute the bulk of the seed, and which are designed for the first nourishment of this tender plant; but Dr. *Grew* is the only author, who has observed that the *Farina*, or fine powder, which is at its proper season shed out of those *Theca* or *Apices seminiformes*, which grow at the top of the *Stamina*, does in some measure perform the office of a *Semen masculinum*, which he supposes only to drop upon the outside of the *Uterus* or *Vasculum seminale*, and to impregnate the included seed, by some spirituous emanations or emergetical impress: What is now the subject of enquiry is, whether it be not more proper to suppose, that the seeds which come up in their proper *Involucra*, are at first, like the unimpregnated *Ova* of animals; that this *Farina* is a congeries of seminal plants, one of which must be conveyed into every *Ovum*, before it can become prolific; that the *Stylus*, as Mr. *Ray* calls it, or the upper part of the *Pistillum* as Mr. *Tournefort* calls it, is a tube designed to convey these seminal plants into their nest in the *Ova*; and that there is such a vast provision made thereof, because of the odds there are, whether one of so many shall ever find its way into, and thro' so narrow a conveyance; to make this supposition the more credible, Mr. *Morland* lays down the observations he has made upon the situation of these *Stamina*, and the *Stylus* in some few species of plants. 1. In the *Corona imperialis*, where the *Uterus* or *Vasculum seminale* of the plant stands upon the centre of the flower, from the top of which arises the *Stylus*; the *Vasculum*
semi-

seminale and *Stylus* together representing a *Pistillum*; round this are planted six *Stamina*; upon the extremities of each of these are *Apices*, so artfully fixed, that they turn every way with the least blast of wind, being in height almost exactly equal to the *Stylus*, about which they play, and which in this plant is manifestly open a-top, as it is hollow all the way; to which we may add, that upon the top of the *Stylus* there is a sort of tuft, consisting of pinguid *Villi*, which Mr. *Morland* supposes to be placed there, to catch and detain the *Farina*, as it flies out of its *Theca*; from hence he also supposes, that the rain either washes it, or the wind shakes it down the tube, till it reaches the *Vasculum seminale*. 2. In the *Capri-folium*, or honey-suckle, there rises a *Stylus* from the rudiments of a berry, into which it is inserted, to the top of the monopetalous flower; from the middle of which flower are sent forth several *Stamina*, that shed their *Farina* out of the cases upon the orifice of the *Stylus*, which in this plant is villous or tufted, upon the same account as the former is. 3. In *Allium*, or common garlic, there arises a tri-coccous *Uterus* or seed-vessel, in the centre of which is inserted a short *Stylus*, not reaching so high as the *Apices*, which thus over-topping it, have the opportunity of shedding their globules into its orifice the more easily; for which reason, he could discern no tuft on this, as on the former, to ensure their entrance, that being provided for, by its situation just under them.

Nothing can be more natural than to conclude, that where a fine powder is curiously prepared, carefully repositied, and shed abroad at a peculiar season; where there is a tube planted in such a manner, as to be fit to receive it, and such care in disposing this tube, that where it does not lie directly under the cases that shed the powder, it hath a peculiar *Apparatus* at the extremity to ensure its entrance; so that nothing can be more genuinely deduced from any premises, than it may from these, that this powder, or some of it, was designed to enter this tube; if these *Stamina* had been only excretory ducts, as has been hitherto supposed, to separate the grosser parts, and leave the juice designed for the nourishment of the seed the more reserved, what need was there to lodge these *Fæces* in such curious repositories? They would have been conveyed any where, rather than where there was so much danger of their dropping into the seed-vessel again, as they are here; again, the tube over the mouth of which they are shed, and into which they enter, leads always directly into the seed-vessel; to which we may add, that the tube always begins to die, when these *Theca* are emptied of their

contents; if they last any longer, it is only whilst the globules, which enter at their orifice, may be supposed to have finished their passage; now can we well expect a more convincing proof of these tubes being designed to convey these globules, than that they wither, when there are no more globules to be convey'd? And could it be shewn that the *Ova*, or unimpregnated seed, are always to be observed without this seminal plant, the proof would arise to a demonstration; but Mr. *Morland* having never discerned this, he recommends the enquiry to others; tho' in the mean time, he had made some steps towards a proof of this sort, and had met with some such hints as made him not despair of being able to do it; for, not to insist upon this, that the seminal plant always lies in that part of the seed, which is nearest to the insertion of this *Stylus*, or some propagation thereof into the seed-vessel; he discovered in beans, pease, and *Phaseoli*, just under one extremity of what we call the eye, a manifest perforation (discernible by the larger sort of magnifying glasses) which leads directly to the seminal plant, and at which, Mr. *Morland* supposes, the seminal plant entered; and he is apt to think, that the beans and pease which do not thrive, will be found destitute of it.

In leguminous plants, if we carefully take off the *Petala* of the flower, we shall discover the pod, or *Siliqua*, closely cover'd with an involving membrane, which, about the top, separates into several *Stamina*, each being fraughted with its quantity of *Farina*; and these *Stamina* are bound close upon the brush, which is observable at the extremity of that tube, which here also leads directly to the pod; it does not indeed stand upright, but bended in such a manner, as to make almost a right angle with it: In roses there stands a column, consisting of several tubes clung closely together, tho' easily separable, each leading to its particular cell, having the *Stamina* in great numbers planted all round: In *Tithymalus*, or spurge, there rises a tri-coccos vessel, that, whilst it is small and so not easily discernible, lies at the bottom, till it is impregnated; but afterwards, it grows up and stands so high upon a tall pedicle of its own, as would incline one to think, that there was to be no communication betwixt this and the *Apices*, which he sees dying below: In strawberries and raspberries, the hairs which grow upon the ripe fruit, are so many tubes, each leading to its particular seed; and therefore, we may observe, that in the first opening of the flower, there stands a ring of *Stamina* within the *Petala*; and the whole inward area appears like a little wood of these hairs or pulp,

which, when they have received and conveyed their globules, the seeds swell and rise in a carnosous pulp: Mr. Morland from this theory only suggests, that hence one may conclude, that the *Petala* of the flower were rather designed to sever superfluous juices, from what was left to ascend in the *Stamina*; than the *Stamina* to perform this office, either for them, or the unimpregnated *Semina*; and he observes, that there should be an analogy between animal and vegetable generation. Plate VIII. Fig. 16. represents a yellow lilly; A the top of the *Pistillum* or tube, at which the seminal plants are supposed to enter, and thro' which they are conveyed to the unimpregnated seeds in the seed-vessel; *b, b* the *Apices semini-formes*, which when open, shed that powder, which enters the tube at A; C the place of the seed-vessel at the bottom of the tube, the tube-vessel itself being concealed under the leaf in this Fig.

Fig. 17. D represents the *Siliqua* in a flower of a pea-kind; E the tube which arises from the *Siliqua*, and conveys the plants thereto; F the membranous coat that involves the *Siliqua*, laid open; *g, g, g, g* the *Apices*, which, before the membranous tegument is laid open, appear to arise from its edges, and by the *Petala* of the flower, are kept close upon the orifice of the tube, that they may conveniently shed their *Farina* into it.

Fig. 18. a *French-bean* represented side-ways.

Fig. 19. the same opened; *b* the seminal plant; *i* a perforation, at which it is supposed the seminal plant first entered.

An Experiment to discover the Cause of the Motion of the Dura Mater; by Dr. Ridley. Phil. Trans. N^o 287. p. 1480. Translated from the Latin.

DR. Ridley having read (in *Baglivi's* book *de Fibrâ motrice*) a new hypothesis different from what the Dr. had some time before laid down in his *Anatomia de Cerebro, Cap. 6.* concerning that alternate motion of the *Dura Mater*, which is visible to the naked eye in wounds of the brain, and in animal vivisection; he thought it incumbent upon him, without taking any notice of the consequences of *Baglivi's* hypothesis (which may, perhaps, be true, tho' it should be supposed that the *Dura Mater* does derive its motion from some other cause, than from itself) to review what he had said upon this subject: *Baglivi*, besides several other places of his book, has the following passage in p. 20. *As soon as I saw this boy, says he, I immediately concluded, that the Dura Mater did not derive its strong and alternate motion from the arteries, which are disseminated therein,*

therein, but from its own peculiar contexture, which emulates that of the heart; and a little above he calls the *dura Mater* the heart of the brain; and afterwards, p. 29, wherewith he says he, the cause of the pulsation of the *Dura Mater*, is to be sought for in its whole bulk and proper substance, and not from any external cause.

Dr. Ridley in his book, cap. 6. speaks to the following purpose; most of the ancients, as also some of the moderns, especially the famous Dr. Willis and Vieussens, have ascrib'd the *Systole* in these *Sinus's* to be owing to some arteries that terminate therein; but I being a little doubtful on this head, made the following experiment; having tied and conveniently placed a dog, and taking away a portion of the skull, I could not observe any pulsation either in the *Dura Mater* or its longitudinal *Sinus*; but in a little time after, the said *Sinus* bursting by the accidental touch of a red hot iron, there was a great effusion of blood, and it was after a considerable depletion of the vessels, that the blood flowed in a salient manner, with an observable pulsation in that *Sinus* and in the whole *Dura Mater*; I cut this *Sinus* lengthwise, in order to trace (but all to no purpose) amidst this salient stream of blood, the insertion of some arteries, several of which Vieussens and before him the learned Wepfer affirm'd they had seen inserted therein; from hence it appears evident, contrary to the opinion of Bourdon, that these *Sinus's* according to Fallopius, Volch. Coite and others have no other motion, but what is communicated to them, in common with the *Dura Mater*, from the arteries disseminated thro' the substance of the brain, and by a sort of co-operation, from the arteries in the membrane itself; for further satisfaction, the Dr. made the following experiment on a dog; having perforated the superior part of the *Bregma*, he laid bare the *Dura Mater*, not without some effusion of blood; and stopping directly the hæmorrhage with lint, and wiping off the blood, the *Systole* of this membrane, as also of its longitudinal *Sinus*, which went along the edge of the perforation, corresponded exactly to the pulsation of the heart, which was quicker than ordinary; this pulsation continu'd $\frac{1}{4}$ of an hour, after which the Dr. laid hold of the membrane with a sharp hook, that by keeping it suspended thereby, and dividing it with a knife, he might the better find out the motion of the brain beneath it; after making a perforation (of which the dog seem'd to have a very quick sensation) there ensu'd an hæmorrhage, which was soon stopp'd as before, yet without

any convulsions; after wiping off the blood, the *Systole* of the brain appear'd to force out, at the little hole which was made in the *Dura Mater* by the puncture of the hook, that little quantity of blood that remained therein; then carefully introducing the blunt point of a pair of scissars into the aperture of the wounded membrane, he cut it transversely, on the side that was furthest off from the longitudinal *Sinus*; whereupon, the brain envelop'd in the *Pia Mater*, came thro' that aperture, its motion still continuing strong to the touch, tho' the membrane itself appear'd to the naked eye to have but a weak vibration, because the elastic power of its fibres was diminish'd by the wound; all this time the dog was lively, being only affected with slight tremors, and with a kind of shuddering all over his body; after spending some hours in observing these things, during which the animal had been variously excruciated, and lost a good deal of blood; at length, in order to destroy the *Vis Pulsifica*, which might be suppos'd to be either inherent in this membrane, or to be deriv'd to it from some other part by means of its fibres, he gently pour'd a few drops of the oil of vitriol upon it, whereby it was tinged black; after this it had no vibration, at least none that was very perceptible; yet notwithstanding this, its unfitness to obey the impulse of the brain, upon applying the finger, the pulsation of the brain was felt sufficiently distinct; afterwards, the dog still continuing lively, upon plunging the point of his knife an inch deep into the substance of the brain, the animal made violent agitations, and fell into a horrible tossing of his body, and into convulsions of his fore and hinder legs; and at that time putting his finger as before, into the said aperture, he felt a stronger pulsation still; then forcing a probe deeper down, the animal gave signs of exquisite pain; at length running the knife thro' the brain quite to the opposite side of the skull, horrible convulsions ensued; and now to remove all doubt about the motion of the brain, both the Dr. and the by-standers felt a very strong *Systole* and *Diastole*.

Amidst several authorities the Dr. might give, he only quotes the following observation made by *Theodore Moeren*, in the *Miscellan. Curios. German. Decur. 2. An. 4. Anno 1683 Obs. 129.* This great contusion had burst, says he, both the *Dura Mater* and *Pia Mater*, and confounded the very substance of the brain; and the blood which had insinuated itself into its glandulous cavities, was gently dried up with cotton fastened to a style; after that, cleansing the wound and making proper applications

cations both internally and externally, we roll'd bandages round the head; what was surprizing was, that the substance of the brain, by its continual pulsation, had acquired a fungous protuberance; which requir'd to be cut twice every day; Dr. Ridley himself had formerly seen a like instance, wherem the patient was for some time dress'd every day by a skillful surgeon.

As to the office assign'd this membrane by *Baglivi*; viz. that thereby the cortical substance of the brain being more closely compress'd, the more animal spirits are produced and convey'd to the remotest nervous parts of the whole body; the Dr. would have it to be first observed; into how many various ramifications the carotid arteries (as soon as they arrive at the brain) are propagated thro' all its parts both medullary and cortical; so that according to *Malpighi* they make a third of all the arteries in the whole body; which computation the Dr. found to be pretty near the truth, after injecting them with red wax. 2. He observes that the *Cortex* of the spinal marrow (where we must necessarily allow that the animal spirits are both generated and constantly distributed) has an inverted situation, being internal; and, that the medullary part, from which the nerves proceed, is external; so that the application is easy.

Remarks on M. Leewenhoeck's Observations on Green-weeds and Animalcula. Phil. Trans. N° 288. p. 1494.

OUR author observ'd the same *Animalculum* M. *Leewenhoeck* speaks of Phil. Trans. N° 283. which he found in the beginning of June in some clear water, he took up in a ditch at *W*—, in which, with his utmost attention, he could discover no more than this single one of the same kind.

Plate VIII. Fig. 20. represents it in one of the postures it appear'd in the first day, (for it varies every moment) and the knob at *a*, which look'd like the gut *Cæcum*, was sometimes a little more lengthen'd; two days after, he could perceive two or three white fibres at the extremity thereof; and on the fourth day, the animal lying stretch'd at its full length, appear'd as in Fig. 21.; and he plainly saw, that what he suppos'd an excrescence was a young one, with six horns, coming out of the side of the old one; and the next day he found it in the water entirely separated from its body, and it was about $\frac{1}{3}$ of the length of its parent; the formation of the horns are well represented by M. *Leewenhoeck*; and they issue like radii, not from the extremity, but quite round a small knob, which

which our author takes to be the head; the horns have a vermicular motion, and are extended or contracted both all together and severally; the other extremity is flat, which it often fasten'd like a leech, to the bottom or side of the glass in which he kept it; it also contracts and dilates its body at pleasure, and especially, when touch'd or disturb'd, it will bring both body and horns into a small compass, and has then the appearance of Fig. 22. and 23. the horns are perfectly white, and the body yellowish, and not easily discernible in the water by the naked eye, it being when extended, no thicker than a large horse-hair.

The small plant mention'd in the said Transl. is the *Lens palustris* or duck-weed, which floats plentifully on our ponds or ditches; but our author dissents from M. *Leewenboeck*, where he says it does not come originally from the bottom; for several years ago, W—— Ch—— Esq. shew'd him the manner of its springing out of the mud; and they often observ'd, that when the leaves were grown to a competent size, the force of the water easily drew up the minute single-fibred root, and rais'd the plant to the surface; our author acknowledges, that the leaves when floating, continue to grow, and may be increas'd in the manner M. *Leewenboeck* mentions; and he has often taken the young plant, which M. *Leewenboeck* has represented, out of them, so that they may be call'd seeds more properly than leaves; and our author's opinion is, that towards the end of the year, upon their corruption they sink to the bottom, and take root there, so as to continue the succession.

The *Animalcula*, which M. *Leewenboeck* describes sticking to the root of the plant, our author has often observ'd, not only in water-plants, but adhering to the bodies of several sorts of water-insects, which he has seen cover'd almost all over with tufts of them; each tuft consisting of several *Animalcula*, which appear not much unlike the flowers of a lilly or fox-glove; this congeries of *Animalcula* will lengthen and contract themselves both all together, and severally; and he has observ'd, when they lie at length, that they exert exceedingly minute organs, like small feet (not easily discernible even with his best glasses) which by their quick agitation bring a current of water from all sides towards them; but he never saw that motion in them, which M. *Leewenboeck* says, resembles that of a mill-wheel; nor indeed, can he perceive the possibility of such a rotation of any member in an animal mecha-

mechanism; but he thinks, he can easily account for this mistake of M. *Leeuwenhoeck's*, or rather of his painter; for in the same water, wherein he has seen these plants and *Animalcula*, he observ'd a small round animal, whose numerous legs stand like *Radii* all round its body, this has a swift progressive motion, but will very often lie still (when only you can perceive those *Radii*) and then turn very swiftly round like a wheel, sometimes one way, and then stop and turn the other way, without stirring an hair's breadth forwards; now it is very probable, that one of these might shew its motions so very near to or amongst a tuft of the other fix'd *Animalcula*, that it might be very readily taken for part of the same, and he is very confident this is matter of fact: These *Animalcula* are sometimes seen loose; but generally, they are fasten'd in clusters by their tails to other bodies, and perhaps, cannot separate themselves; and our author takes it to be no mean instance of a providence, that several kinds of water-insects, which are so fix'd, and even some of which have but slow and irregular motions, are furnish'd with such organs about their head, the vibration of which brings a constant current towards their mouths, and with that food for their support; otherwise, they would be starv'd for want of nourishment: The insects on which he has seen these *Animalcula* are of divers sorts; and he has observ'd no small variety in the water of our ditches, not only of reptiles, and the caterpillar kind, but of eels and perfect shell-fish, both crustaceous and testaceous; Fig. 24. and 25. represent two sorts of the crustaceous kind, as they lie in a swimming posture, with their backs towards you; but the members and legs on the other side are so various, and so much more curiously form'd, than those of lobsters and shrimps, that he despair'd of giving any tolerable representation of them in any other position; these are about the same size, the biggest being rather less than a very small flea, and the least a little bigger than a mite; but all are breeders, and carry their spawn at their tails; that represented by Fig. 24. carries it in two bags, one on each side; which are fasten'd about the fifth joint, and the other in a single bag or film under the tail; and he has often seen these bags broken, and the spawn (which is globular and large in proportion to the fish) scatter'd thro' the water; there is also amongst these a third sort of the same kind, not less elegant, tho' far less in bulk, which is shap'd more like a shrimp, and also carries its spawn like that; all these three species, as also some other water-insects,

insects, are certainly monocular, and have their eye exactly in the middle of the head; and he could never, with his utmost application, find so much as a dividing line therein; some of them, especially in some waters, are dark and cloudy; but generally, they are so transparent, that thro' the shell he could see the peristaltic motion quite thro' their whole length, and a constant pulsation of a part, which he took to be the heart; but he could never discover any circulation of blood in them (nor even in shrimps, which are as big as some thousands of these) tho' he had seen it plainly in animals a little bigger; viz. the smallest new-hatch'd spiders, and in that water-insect which is describ'd and represented, tho' not accurately, by *Swammerdam* under the improper name of *Pulex aquaticus*; but this is of the testaceous kind, of which our author has seen a greater variety, and not less curious than those of the crustaceous kind.

Our author farther observ'd the *Lens palustris*, and he is fully satisfied of the truth of its first springing from the bottom; he took up some on the shallow side of a pond, and found the extremities of the stalks (most of which were at least five inches long, and as thick as a strong horse-hair) manifestly rooted in the bottom, so that he could not take them up, without raising the mud at the same time, which also adher'd very visibly to them; these stalks or roots are of a curious texture, and almost transparent; and he has seen their outside very prettily cover'd with a regular sort of net-work; *M. Leeuwenhoeck's* figure represents them but badly; in his observations of these stalks, our author often saw adhering to them (and sometimes separate in the water) several pretty branches, compos'd of rectangular parallelograms and exact squares, which were join'd together, as in Fig. 26; there are often 20 or more of these figures in one branch, which generally adheres at one extremity to the stalks of the plant; and it is remarkable, that these rectangular parallelograms are all of the same size; the longest side does not exceed $\frac{1}{2}$ of a hair's breadth, and the length is just double the breadth, the squares being visibly compos'd of two parallelograms join'd lengthwise; they appear very thin, and the texture of each is nearly the same; to a very large magnifier they appear as in Fig. 27; he took these branches at first for salts, but upon finding them always of the same size, and that there was no sensible increase of their bulk, while they continu'd in the water; that after they had lain a day or two dry on a glass-plate, they did not

not alter their figure, and upon the addition of new water, warm or cold, they still had the same appearance and cohesion, and that their adherence (tho' touching only in the angular points) was so firm and rigid, that all mov'd together, and kept the same position in respect of each other, however agitated by the water; these considerations persuaded him, that they might be plants, rather than salts; but they being so very minute, that no judgment could be made of them, but by the eye, he would not determine any thing positively.

In some water which he took out of a pit, he found a small *Water-newt*, not an inch long, which he took to be of the same year's brood; and the legs being so small, as not to be readily discern'd at first view, and the body being very clear, he at first sight took it for a fish; this he kept by him (instead of tadpoles) to shew the circulation of the blood in its tail; and not only so, but he found the circulation of the blood in every part of its body, and particularly in every toe of the feet; it was a curious sight to observe, the stream come to the extremity of the toe in one channel, and return by another; in this *Newt*, just below the setting on of the head, on each side, are three little rugged fleshy branches, which it spreads like fins, and they help to poise its body, observing these with the microscope, he found each of them divided (something like a leaf of polypody) into a great many pointed branches; in each of which as in the toes, he could see the blood come to the extreme point on one side, and return on the other; and 30 or 40 of these branchings would sometimes appear at one view, and the blood be seen distinctly circulating in all; for as Mr. Cowper rightly observes, the globules of the blood of these animals are very large, so that he could see the circulation in them very well, even with the smallest magnifiers, which take in a large area; and from what has been said of this circulation of the blood, our author is persuaded, that these organs in the *Newt* are not only design'd to be serviceable in their swimming, but (tho' they have lungs like a frog) may also be analogous to the gills in fishes.

In his examination of the waters of our ditches (in which he daily found new varieties of *Animalcula*) he met with great numbers of those round bodies so well describ'd by M. Leewenhoek Phil. Trans. N^o 261; and whilst he was observing them he saw a very surprising *Phænomenon*; viz. each of those spherical bodies (which are smaller than a mustard-seed) had a constant progressive motion, and at the same time a slow

revolution about their own axis, and contained within them other small globules, some more, some less; but he never found above ten in one; and these he has seen move and change their position within the other, which M. *Leeuwenhoeck* says he never observ'd; while our author had one of these bodies on a glass-plate before his microscope, he saw (as M. *Leeuwenhoeck* describes it) one of the contained globules slip out of it; and while the large one lay still, for want of sufficient water to float in, this small one that came out had immediately a very quick rotation on its axis; and what was most surprising, at the same time it kept an equable revolution about the larger globe, as the centre of its orbit, always very nearly at the same distance, tho' he could not perceive any vortex in the water which bore it; and what was still more remarkable, he saw it stop, and then make its revolution round the central body the contrary way, the rotation on its own axis always continuing; and when the water was so far evaporated, that all lay at rest, by the addition of more water the same motions were renewed; this he thought a very pretty representation of the planetary motions about the sun; our author thinks, that it is not easy to account for the motions of these globules; nor will he, to solve the difficulty, say in contradiction to M. *Leeuwenhoeck*, that he takes them to be animate, tho' he has formerly seen some not very unlike them both in shape and motion, which he was satisfied were animals.

Our author found all the earwigs, which he examined by a microscope, infested with great numbers of minute insects, which stick like lice on several parts of their bodies, and especially just under the setting on of their heads; they are alike on all, and he never found the same on any other animal; they are white and shining like mites, but much smaller, are round-back'd, flat-bellied, and have long legs, especially the two foremost ones.

Spots observed in the Sun; by Mr. Stephen Gray. *Phil. Trans. N^o 288. p. 1502.*

JUNE 15th, 1703, between 4 and 5 o'clock in the afternoon, Mr. Gray saw a spot in the sun, by placing a piece of white paper so far behind the telescope of six foot, as to give the image of the sun nine inches diameter; the spot was in the lower right hand quadrant of the sun's disk, its form was almost round, inclining to an ellipsis; it was distant from the limb of the sun about six or seven inches, and its diameter he judged to be about 10 or 12 seconds; a little before the setting of the sun, he saw the spot with a 16 foot telescope, and he could perceive that it was

fur-

surrounded with a mistiness; on the 16th he saw the spot again about two in the afternoon, and found that it had advanced near the western limb of the sun; the 17th was cloudy, and so was the night, which hindered Mr. Gray from observing the eclipse of the moon; the 18th, in the afternoon, it cleared up, and a little before five, he saw the spot with the 16 foot telescope thro' thin clouds, and he found that it was now very near the limb of the sun, little more than half a minute; it was much contracted in its breadth, so as to be four or five times longer than it was broad; on the 19th, in the morning, he looked for it again, but he could not see it; so that Mr. Gray concluded, it was then either gone off the disk of the sun, or if it adhered to the limb, the great tremulation of the atmosphere hindered him from seeing it.

Astronomers have found by these spots, that the sun revolves upon its axis, so as that in 27 days, the same point in the sun's disk returns to the same place it was seen at from the earth; hence its semi-revolution is in 13 days and a half; and consequently the spot going off the sun's disk the 19th of *June*, it might be expected to return the 2d of *July* following towards the eastern limb of the sun's visible hemisphere, if it be not dissolved before that time.

Plate VIII. Fig. 28. expresses the appearance, but not having the conveniency of measuring the angle of the spots way with the vertical, it is only guessed at.

June 26th, 1703, in the evening, Mr. Gray looked, whether there were generated any new spots in the sun, but he found none; on the 27th, about half an hour after eight in the morning, by receiving the sun's image on white paper from the 6 foot telescope, he saw a spot near the sun's vertical towards the lower limb; betwixt nine and ten he elevated the 16 foot telescope, the clouds being now of a convenient thickness to let him view the sun, he found that this spot was of a triangular form, and that it was accompanied with two other smaller ones, as expressed in Fig. 29; the sides of the large spot were curvilinear, and this with two smaller ones made an equicrural triangle; at four in the afternoon, the triangular spot had a small fragment separated therefrom, and itself was now become elliptical; the spot *b* was much augmented, but the spot *c* was diminished, and became longish, as in Fig. 30; at half an hour after five, the fragment from the large spot was divided into two, and the spot *c* was so narrow, as to be scarcely visible, as at Fig. 31; about 30 minutes after 6 o'clock, there was a small fragment separated

from the lower extremity of the large spot, as in Fig. 32; at 7 o'clock the spot C was much increased, but *c* was vanished, the observations were made this afternoon with the 16 foot telescope, when the air was clear, and to secure his eye, Mr. Gray smoked the eye-glass with a wax-candle; the 28th, about seven in the morning, he saw that the large spot was much augmented, but the smaller ones that attended it the day before, were vanish'd; and there were two new ones generated at about one minute and a half distant from the large one below, and towards the left hand thereof, the large one was a parallelogram, with a black diagonal crossing it, as represented in Fig. 33; at 10 o'clock there was another diagonal crossing the former, as in Fig. 34; and the two smaller spots, which before had been longish, had now assum'd a round form, the spot *c* being much larger than the other at *b*: Mr. Gray not having proper instruments to find the position of the sun's spots, with respect to longitude and latitude on the sun's disk, he could only observe the position and variation of the spots amongst themselves.

The Same; by Mr. William Derham. Phil. Trans. N^o 288.
p. 1504.

THE two circles in Plate VIII. Fig. 35, 36, represent the sun's disk; N the northern part thereof, S the southern, E the eastern, and W the western part; wherein also are represented the place of the spots, the manner of their appearance every day, and the day of the month: It is to be observed, that tho' the figures of the spots are done pretty exact, yet their places on the sun's disk are not so, for being unprovided with the proper instruments, Mr. Derham was obliged to represent them, by taking the species of the sun upon paper thro' a telescope, and so marking out their places; since the last appearance of the spots, he invented an exceeding nice micrometer, and provided himself with a watch that beats half seconds; this micrometer is not, as usually, to be put into a tube, but is to measure the species of the sun of any Radius, or paper, or any part thereof, which Mr. Derham takes to be more exact than the common way; by this means he can easily and very exactly, with the help of a fine thread, take the declination of a spot at any time of the day; and by his half-second watch, and a fine cross hair, he can measure the distance of the spot from the sun's eastern or western limb; this cross fine hair should be set, not at the exact focal distance from the eye-glass, as usually, but a little out of that distance, nearer towards the object-glass, because the

the shadow of the hair will thereby be much narrower, and appear the more distinctly cross the species of the sun received on the paper; and this method may likewise be of good use in taking the sun's altitude, measuring his diameter, &c. being a more easy, and perhaps, a more exact way than by looking thro' a tube: The spots on the sun's disk seemed strong enough to have lasted another, or more revolutions, but none have been visible since the 6th of *June*, when Mr. *Derham* had a glimpse of a spot on the sun's western limb, about 7 o'clock in the morning.

The spot in Fig. 35, appeared as it is there represented, first round and strong, afterwards long, and with a *Nucleus*; this very spot Mr. *Derham* doubts not, but he saw again on the sun's eastern side *July* the 5th, but very faint, small, and long, as in Fig. 36, so as to be but just discernible; on *July* the 6th it quite disappeared, both thro' his tubes, and on paper: The spots in Fig. 36, had these remarkable appearances and variations; on *June* the 28th, viewing the sun towards evening, he espied a large strong dark spot, with two or more glaring *Nubeculae* behind it, somewhat like the representation in the figure; these were become next day four strong dark spots, the foremost had a tail to it, conjoining the little spot next it, as in the figure; on *June* the 30th, he saw spots, but it being a cloudy morning, and being absent from his tubes in the afternoon, the representation of them in the figure is not exactly as they appeared; *July* the 4th, there appeared between two long spots, something resembling a round *Nubecula*, as in the figure; the rest were as represented in the figures.

The Invention and Progress of Printing to Anno 1465.
Phil. Trans. N° 288. p. 1507.

WHAT Mr. *Ellis* says, *Phil. Trans.* N° 286. about the books printed at *Haerlem* by *Laurentius Coster*, agreeing so well with the accounts given by *Theodore Schrevelius* and others, leaves us no room to doubt, whether the honour of the invention be due to this or the other cities, whose writers have so eagerly contended for it, since none of them have pretended to shew any book printed so early as *A. D.* 1430 or 1432, or near that time; but the difficulty lies, either in shewing, why the practice of this art should be at a stand from *A. D.* 1432, to the noted reviving of it at *Mentz* by *John Fust* and *Peter Schoeffer*; who (as it has been vulgarly, but erroneously said) printed the first book there, namely, *Tully's Offices*, *A. D.* 1465;

or

or else, in giving any tolerable account of the progress of this invention, during an interval of above 30 years.

Boxhornius, as well as *Schrevelius* and other authors, expressly say, that *Coster* could not advance this invention so far, as to print so large a work as the *Speculum Salutis*, without gradual improvements; and that his first essays were on loose and small leaves of paper, (most of which by being so, are all supposed to be lost) before he had attempted whole books; but this gentleman had once observed a loose leaf of paper in *Octavo*, lying in an old MS breviary, in her majesty's royal library at St. James's, which he supposed to be one of *Coster's* first pieces, done when he had attained to some experience in the art, and to get money; it is a rude small wooden cut of the five wounds of our Blessed Saviour, and the instruments of his passion, with a *Latin* inscription at the bottom; to this purport, that such as would say so many *Ave Maria's* before it, would have so many 1000 years pardon; the ink in this cut or print was writing-ink, and it was all black, without those other colours wherewith *Coster* afterwards adorned his books: In the above-mentioned *Boxhornius's* book *de Origine Artis Typographicae*, it is said, that *Hadrianus Junius* had a book printed by *Coster*, and like that kept in the chest at *Haerlem*; now, amongst those books bequeathed to the *Bodleian* library at *Oxford* by Mr. *Francis Junius*, (a kinsman of *Hadrian's*) there is a thin small *Folio* numbered 31, which may probably be the same, and which one Mr. *Foss a Dane*, assured this gentleman was very like that at *Haerlem*; this contains the sum of the history of the old testament, represented in rude wooden cuts, coloured with divers colours, without any shading, resembling our cards (which, with sheet-ballads, are remains of the old manner of printing) and stamp'd on one side only; the white sides of two leaves being pasted together; the black both in the pictures, and in the inscriptions which shew their meaning, being writing-ink (as in the aforesaid leaf) is artificially spread upon the wooden block, here thick and there thin, spreading and yellowish; the letters are extremely rude, and altogether manifestly shew, that the art was yet in its infancy; the stamping of this book on one side only, was not, because the printer did not know how to dispose the pages in such a manner, as might be proper and easy for the book-binder's use; for it has its signatures all along in majuscule letters, set in the middle of the page; but because, it was thought, that the paper would not bear a second impression on the backside; just as the book-writers of those times (when paper began to be cheap, and to be made

up into books) would yet have the first and last leaf of each *Quaternio*, *Senio*, &c. to be of parchment for strength sake: This book is imperfect, and has no date now appearing, and perhaps never had any; nor has such another book as this, which contains the history of *St. John* and the *Apocalypse*, in such like wooden-coloured pictures and inscriptions; this is inscribed *LAUDE 65*, and it is in the same *Bodleian* library, and has also its signatures in majuscule letters; which this gentleman observed in several MSS of different ages, as high as 1000 years ago and upwards, expressed either by letters or numbers; this book, tho' printed but on one side, and pasted as the former, is yet more elegant, and shews that the art was much improved; and in the same library *Arch. B. Bodl. 88*, there is an ancient MS, with the same figures and inscriptions, tho' the habits of the figures are different, being of an older fashion; and it is very likely, that there is another copy of this book in the emperor's library at *Vienna*; for, *Lambecius*, in his *Comment. de Biblioth. Cæs. Lib. 11. p. 772*, reckons, amongst those which he brought away from the arch-ducal library at *Innsbruck*, a book of which he gives the following account; *Apocalypsis S. Joannis Apostoli & Evangelistæ Latino-Germanico, chartacea in Folio, una cum Vitæ ipsius, & multis figuris ligno incisiss, quæ propter vetustatem suam spectatu sunt dignissimæ*; and in this book at *Oxford*, besides the printed cuts, there is also a commentary upon the *Apocalypse* in *High Dutch*; besides these two very ancient printed books, Mr. *Bagford* told this gentleman, that in the manuscript library of *Corpus Christi* or *Bennet-College* in *Cambridge*, he saw a third, containing the history of our Saviour, printed only on one side of the paper, with such like wooden cuts, but yet more neatly done, than either of the former at *Oxford*; and these three books, being stamped but on one side of the leaf, the whole being wrought or cut upon wood, not set or composed with printing letters, and printed with writing-ink, do sufficiently demonstrate, that the art was as yet in its infancy; and may, tho' they bear no workman's name, be very reasonably ascribed to *Coster*; not only, because no other person lays claim to them, but because, in divers circumstances, they agree with the history of the man, and with what remains of his workmanship: If it be asked, why *Coster* did not set his name and the date to these books, as well as to that at *Haarlem*, mentioned by Mr. *Ellis*? It may be answered, that *Schrevelius* tells us, that *Coster* bound *Fust* above-mentioned by oath to secrecy, and not to betray the art to any person whatsoever; wherein it is likely, that

that his design was not so much to let the world think, that he had a new way of multiplying the copy of a book much quicker than the quickest penman, but that he designed to impose upon the world, by selling his printed books for new written copies; whereby the book-writer and illuminator must (as he might well pretend) be so paid for their work, as to maintain themselves and families; this trick might for a long time be undiscovered in and about *Haerlem*, because there was no other printing, whereby this might be contradicted; but at length, as *Boxhornius* and *Schrevelius* write, *Fust* run away with all his master's tools and materials, and in process of time he set up a printer's shop at *Mentz*, assisted by his servant *Peter Schoeffer*, a young man of a good genius; who afterwards married his daughter, and became his partner in the business: The story goes, that this *John Fust* went to *Paris* (but whether before or after his settling at *Mentz*, our author cannot tell) and that he there offered a great number of printed bibles to sale, as if they were manuscripts; but the *French*, considering the number of these books, and their exact conformity to each other throughout the whole, to a line, a word, a letter, a point; and that the best of book-writers could not be thus exact; and therefore by indicting him (or threatening to do it) of diabolical magic, they at once gave birth to the story of *Dr. Faustus*, and obliged him to discover the art; and our author does not doubt, but that, about this time, a great many books were printed and sold for manuscripts; he having seen divers such books without dates, which looked rather older than any he saw with them; those our author now speaks of, are set or composed of letters, which, together with printing ink, made of lamp-black and oil, and the printing-press, is said to be the improvement of *Schoeffer* above mentioned; tho' *Schrevelius* with less reason ascribes the two former to his countryman *Coster*.

When *Fust* and *Schoeffer* began first to work at *Mentz* is uncertain; but the first mention our author finds made of him, is in *Schrevelius's Haerlem*, p. 272, where he says, that this *Fust* or *Faustus*, as he calls him, published *Alexandri Doctrinale cum Petri Hispani Tractatibus*, A. D. 1442; but this and some other books mentioned by writers on this subject, are never said to be extant in any particular place, to be consulted on occasion; and therefore, their titles and dates are not so much to be relied upon; but another date, which, tho' not so old, is more authentic, and to be found in the above-quoted book of *Lambecius* p. 989; where he says, he brought from *Inspruck*, amongst other

other choicest volumes, and placed in the imperial library at Vienna, a psalter printed upon parchment, with this inscription at the end; *presens Psalmorum Codex conuultate Capitalium decoratus, rubricationibusque sufficienter distinctus, adinventionem artificiosam imprimendi & characterizandi, absque calami ulla excavatione sic effigiatus, & ad eusebiam Dei industriam est consummatus per Joannem Fust Civem Moguntinum, & Petrum Schoeffer de Gernsheim, Anno Domini millesimo CCCCLVII in Vigilia Assumptionis*: From this time there are constant remains of the industry of these men, and he could mention more books printed by them, than the *Durandus* in the library of *Basil* in Switzerland, printed (as a gentleman who saw it told him) *A. D.* 1458, *Joannes Joannensis's Catholicon* (in her majesty's and the lord bishop of *Norwich's* libraries) printed 1460; the *Latin bible* of 1462, still extant in the *French king's* library, and in divers monasteries beyond sea, and perhaps in *England*; *Tully's Offices* printed both in 1465 and 1466 (if both these are not the same edition, the last sheet or leaf having been composed a-fresh) and so on, till *Schoeffer* work'd for himself after the death of *Fust*, and *Schoeffer's* posterity after him.

Upon the first discovery of the art by *Fust* at *Paris*, or at his first settlement or public profession thereof at *Mentz*, it quickly spread over the best part of *Europe*; and from these places, and from books or parts of books, where, or wherein such sorts of letter were used, the printers do still call their letter, *Valic*, *Roman*, *English*, *Austin*, *Canon*, *Pica*, *Primer*, *Brexier*, &c. and printing was commonly used in other countries, before it was known in *England* (notwithstanding what some writers affirm to the contrary) the first book that we pretend to have been printed here in *England* being *Hierom*, or rather *Rufinus* on the creed, printed at *Oxford*, *A. D.* 1498.

To prove this in some measure (not to mention the progress of printing in other countries) our author instances in *Italy*, and particularly *Rome*; here, not to insist on the large catalogue of printed books described in an epistle to pope *Xystus IV.* publish'd at the beginning of the 5th tome of the bible, printed with *Lyra's* commentaries at *Rome*, *A. D.* 1472, and transcribed by *Boxhornius*; our author only relates the substance of what he met with in *Bernard Montfaucon's* *Diarium Italicum*, tome I. p. 255, 256; viz. that *Joannes Alericensis*, in a flattering epistle to Pope *Paul II.* (who was elected *A. D.* 1464) congratulates him, because printing was first used at *Rome* under his Pontificate; which is meant of the very first practice of the art at *Rome*, and

not of an established imprimery, seems to be false; because, this learned Monk, in the same place, says, *He saw a Lactantius in the Musæum, or study of M. de la Thuilliere, which has these words at the end; Lactantii Firmiani Institutiones cuse in venerabili Monasterio Sublacensi, Anno 1461, antepenultima Octobris*; now, unless a man will suppose printing to be invented in this monastery, he must believe it to be brought hither from Rome, which is but about 20 miles distance from it; and the same author says, that *Floravantes Martinellus* in his *Roma Sacra*, affirms that printing was practised at Rome in the palace of the Maxime, A. D. 1455, under Pope Nicholas V. by Conrad Sweynheim and Arnold Pannartz, who were both Germans, and continued printers there for several years after.

The custom of putting the dates of printed books at the end of them, was taken up in imitation of divers manuscripts of the middle and latter ages (for our author never saw nor heard of any ancient manuscript in capital letters, either Greek or Latin, which has a professed date written in the first hand) but here one ought to be cautious, lest he be led into an error; for, several manuscripts at the end have a date, which may be understood by some of the time, when those individual copies were written; whereas, they only notify the time, when the author finished his work; and some of these dates having been printed from the manuscripts, have deceived several curious men; for example, the first edition of *Lyndwood, Paulus à Sancta Maria*, and others he could name; besides, some dates in ancient printed books, not being corrected, are false; such was a book printed in the beginning of the 16th century, in the library belonging to the *Ashmolean Musæum* at Oxford, which thus pretends to 4 or 500 years of age; a *Julius Hyginus* was once shewn him by Mr. Millington a bookseller, printed at Paris, as there set down, *Anno Domini MCCCCXII* instead of *MCCCCCXII*; for, the printer is mentioned, as then living in *l'origine de l'imprimerie de Paris*; our author had a book, wherein amongst other tracts, is one of an old print, at the end of which there seems to be such a mistake, tho' not so easily rectified as the former; the words are these, *explicit Opusculum Ence Sylvii de duobus Amantibus in Civitate Leydensi Anno Domini millesimo CCCC quadragesimo tertio LEIEN*; now, tho' *Leyden* seems to be the place where it was printed, yet 1443 cannot be the time; for, just before, *Sylvius* himself says, *vale, ex Vienna quinto Nonas Julias Mo CCCC quadragesimo quarto*; *Sylvius* was elected Pope by the name of *Pius I.* A. D. 1458, and died
A. D.

A. D. 1464; now, it may seem probable, that if this tract was printed after his election, as suppose *A. D.* 1463, or even after his decease, his papal dignity might have been remembered; if it be judged to have been printed before his election, our author knows none that will allow of printing at *Leyden*, or even at *Lyons*, so very early.

One objection may be urged against what is said of *Coster's*, or the old printed books above-mentioned, being printed upon paper about *A. D.* 1430, or soon after; for, some authors are of opinion, that paper made of linen-rags was first made at *Basil*, by some *Greeks*, who fled from their country after the sackage of *Constantinople*, *A. D.* 1452, in imitation of the cotton-paper, commonly used in the *Levant*; but this can have no force, our paper being much older; for our author had a piece, the writing on which seems to be about 350 years old, and agrees very well with a charter, which he had seen of *Thomas Beauchamp*, earl of *Warwick*, bearing date *A. D.* 1356, and the 32d of *Edward* the III. in the archives of the library belonging to the R. R. Dean and Chapter of *Canterbury*; he also saw an inventory of the goods of *Henry*, prior of *Christ's* church there, taken upon his decease, in the 20th year of King *Edward* the III. which was written upon paper; in the *Cottonian* library, he observed several writings upon our paper, in the time of most of our kings and queens, as high as the 15th of king *Edward* the III. and he does not doubt, but there are others more ancient in the same place; but, in the east, the use of cotton-paper is much more ancient, and our author had seen in the *Bodleian* library an *Arabic* manuscript, (amongst those the university bought of *Dr. Huntingdon*) written in the 427th year of the *Hegira*, i. e. *A. D.* 1049; and others in the same place, without dates, seem to be older.

Tho' the invention of the rolling-press is commonly ascribed to *Lipsius*, yet it seems older than his time, from a printed book in the *Bodleian* library, placed *LAUD. D.* 138, which is a *Missale secundum usum Ecclesie Herbipolensis*, i. e. *Wurtzburg* in *Germany*; *Rhodolphus*, archbishop of that church, sets forth in an instrument at the beginning of the book, the reasons why he caused this missal to be published; which instrument bears date the 8th of *November* 1481, by which time he ordered all the copies to be finished by *Forius Ryser* his printer, who seems to have done so, since his name, and this year 1481 is written at the end of the book; instead of a seal to this instrument, there is an engraven print, being the arms of the *See* supported by two angels,

angels, and St. *Kilian* its first bishop and protector behind; as also this prelate's own arms, with those of the See in another escutcheon, and a very fine mantling; this is exceedingly well engrav'd, considering the time, and equals the performances of some of our best workmen at present; the evident marks of pressure by the plate, with some touches of ink at the edges, the roughness of the print, and other circumstances concurring, shew that it must needs be wrought off at the rolling-press; and divers very knowing and curious gentlemen, several printers, engravers and others, constantly working at the rolling-press, all concurr'd at different times, that it was not only extremely well engraven (and this before *Albert Durer's* time) but that it was certainly pull'd from the rolling-press and could be done no other way; and that this print was not done after that time, appears from several notes written here and there in the book; one of them specifies that *William Kewstib*, vicar of St. *Bartholemew's* church in *Wurzburg*, bought this book in the same year 1481, paying 18 *Florins* for the parchment, printing, rubrication, illumination and binding; by another it appears, that he gave it to his church for ever; and by some others, that it remain'd there during the times of his several successors, till the last age, when the *Suedes* under *Gustavus Adolphus*, plunder'd the church, and carried the book away.

Worms observ'd in Sheep's Livers and Pasture-grounds; by *M. Leewenhoeck*. Phil. Trans. N^o 289. p. 1522.

IN the summer of the year 1702, we had not rain enough to cover even the lowest parts of the meadows adjacent to *Delft*; insomuch, that none of the sheep of that year drank of the waters that us'd to stagnate on the said meadows; which when it happens, produces (according to the opinion of our butchers) a certain sort of worms call'd *Borriens* in their livers; notwithstanding which *M. Leewenhoeck* was inform'd, that some of the sheep of those pastures had their livers infected with such like worms, which made him conjecture, that the above-mention'd distemper in sheep's livers, must proceed from some other cause, than their drinking the said waters; therefore, caus'd a butcher (who was proprietor of one of these meadows, and who had also inform'd him, that the sheep he turn'd into that ground were mightily pester'd with worms in their livers) to cut two pieces of green sod from thence, to the end, that *M. Leewenhoeck* might try, whether he

he could find any such worms therein; this land he told Mr. *Leeuwenhoeck* was so high, that it was never entirely under water, in winter time; but the ditches about it were so full, that they were in a manner, level with the land, and some of the lowermost parts of the same, when it rain'd much, were cover'd in a short time; Mr. *Leeuwenhoeck* examined very carefully those two pieces of earth, but he could find no *Animalcula* therein, any way resembling the worms in the sheep's livers; from hence he infers, that the *Animalcula* not only found in sheep's, but in cow's livers too, must not be sought for in those waters that stagnate upon the land, but in the land itself; which being thoroughly wet or soak'd, they ascend to its superficies, because the common water not being natural to them, they cannot live therein; and thus lurking in the grass, they are swallow'd by the cows and sheep, and such as escape their teeth, are convey'd into their stomachs and bowels, and insinuate themselves even into the liver: Mr. *Leeuwenhoeck* was often told, that the cattle which feed in *Siltagtig* grounds are free from this disease of worms; but being inform'd at the same time, that the said kind of ground is very low, and lies under water the most part of the winter, he gave the following reasons; why kine and sheep that feed in high clay-grounds are troubled with worms in their livers, and those in low grounds not; *viz.* only because the low grounds lie all winter under water; for tho' such like worms may be found in some of the low lands, yet as soon as they are overwhelm'd with water, those worms abhorring the water, die immediately; to confirm this reasoning, he took a glass tube, which was an inch wide at the upper extremity, and above a foot long, into which he put a little piece of the above-mention'd earth, near five inches long, but so narrow, and the grass about it clipp'd so close, that it would easily enter the tube without pressing; and then he pour'd upon it boil'd water, which had stood till it was cold; presently after he perceiv'd, that several very small and long white worms came out of the earth, which reaching and incurvating their bodies, leisurely subsided to the bottom of the tube, none of them being able to emerge to the surface; whence he concluded, that they could not live in the water; and in effect, after they had lain 24 hours in the bottom of the glass, he found they were all dead; it appear'd to Mr. *Leeuwenhoeck*, that these white worms were of several sizes, and that they could not be the offspring of our common worms, because they were much longer in proportion to their bigness;

bigness; he also saw a common worm creeping out of the abovesaid earth, which leisurely subsided, and remain'd at the bottom of the tube, with little or no motion, and next day it was dead; some of those small *Animalcula* that came out of the earth, and swam about the water, were so exceeding small, that he could not perceive what figure they were of, tho' he had view'd them very carefully and very frequently; nay, tho' he had shifted the earth and water three times: Now, that these *Animalcula* may be call'd water-worms, tho' they are found in the driest parts of the earth, appears from their living so well in the tube fill'd with water; in which having observ'd them day after day, he found no difference, only that they were increas'd in number; and besides, he has met with several of them in common water: In these observations he discover'd a few particles of sand mix'd with clay, the sides of which appear'd, as if they had been broken or grated off from stones, and some of them were so very small, that above 1000 of them together did not exceed the magnitude of a single grain of common scowering sand.

At another time M. *Leeuwenhoeck* went into one of the meadows near *Delft*, which consisted of a good clay soil, and lay as high as any about town; he dug out a bit, about the bigness of a crown, out of the said soil, which was cover'd with clover-grass, short and fine, imagining, that he should find in the top of it some *Animalcula*, because he had formerly found in the rotten wood of a willow-tree, and in another rotten plank that had lain in the open air, some of these *Animalcula*, which are usually found in water; he clipp'd away the grass from the bit of clay, and put the top of it into a clean glass-tube, as big as a child's finger, and he pour'd thereon boil'd rain-water, after it was cold; and shaking the earth and water well together, the water was so muddy, that he could perceive none of the *Animalcula* therein; but after it had stood about half an hour in the tube, he could see several *Animalcula* creeping up the sides of it, and others swimming about the water; after this water had stood several hours, and acquir'd a little more clearness, he saw two particular *Animalcula*, that in shape very nearly resembled those that exert little wheels out of their bodies, only that instead of such wheels, they protruded a horny part, which they sometimes drew in, and then thrust out again; there was also one *Animalculum* that put out two wheels, and just by, he perceiv'd two other sorts of *Animalcula*, but he immediately lost sight of them again; from whence he

con-

concluded, that so much water was not natural to them, and that therefore they died; and after that the water had stood three days upon the clay, he saw several *Animalcula*, that were four times as long and as thick, clinging to the sides of the tube, without any motion, tho' they stirr'd about briskly at first.

M. *Leewenhoeck* took another glass-tube, and putting therein a little of the same clay, which he handled very tenderly, he pour'd upon it some of the boil'd water as before, without shaking it at all, that the *Animalcula* might emerge the better; and after an hour's time, he saw about 20 *Animalcula* swimming (whereas, he could perceive none in the first) and one of them protruded wheels out of its body: Now it will appear surprizing to some, that these *Animalcula*, which usually and naturally swim in water, should be found in earth that has not been moisten'd by rain or otherwise for several weeks; but M. *Leewenhoeck* has often found by experience, that several sorts of very minute *Animalcula* are to be met with in rain-water, and especially in the gutters on the tops of houses; for he has taken some of the slime or dirt of those gutters, after they have been dry above a year, and diluted the same in boil'd water, after it has been cold, whereupon, he saw several *Animalcula* swimming; and some of them being folded up, almost in a globular figure, extended their bodies leisurely, and then they swam about in the water.

If it be objected, how comes it to pass, that these *Animalcula*, that are merely aquatic, should be found on the land several roods distant from any ditch? To which M. *Leewenhoeck* answers, by supposing that this happens after the following manner; we often find, that in a storm, the water has been so furiously driven against the sides of the ditches, and the parts of such water have been so minurely divided, that not only several of its smaller particles have been carried a great way into the land by a strong wind, but some of them have also been exhal'd, even into the clouds; and he was confirm'd in this opinion, by the following instance; at one time he stood to observe with what force, and at how great a distance, a bleacher casts water with his scoop out of a ditch, upon his linen spread over a meadow, whereby several of the parts of the water were so divided, that they never fell to the earth, but were exhal'd into the clouds: In the said small particles of water are convey'd the above-mention'd *Animalcula* far up into the land, and when the ground becomes dry, they contract

tract themselves into an oval figure, and the pores of their skin are so well clos'd, that they do not perspire at all, whereby they preserve themselves, till it rains; upon which they open their bodies, and enjoy the moisture.

Observations on the great Storm Nov. 26. 1703; by Mr. William Derham. Phil. Trans. N^o 289. p. 1530.

TO look back to the preceeding seasons of this year, *April, May, June and July* were wet months in the southern parts of *England*; particularly, in *May* there fell more rain than in any month of any year since 1696; and tho' *July* had considerable intermissions, yet on the 28th and 29th there fell violent showers of rain; and the news papers gave an account of great rains that month from divers places of *Europe*; but the north of *England* (which also escap'd the violence of the storm) was not so remarkably wet in any of those months; at least, not in that great proportion, more than in the southern parts, as usually they are; particularly *July* was a dry month with them, there being no more than 3, 65 l. of rain fell thro' Mr. *Townley's* tunnel of the same diameter with Mr. *Derham's*; *September* with us was a wet month, especially the latter part thereof; there fell of rain in that month 14, 86 l. *October* and *November*, tho' they were not remarkably wet, yet had been open warm months for the most part; at *Upminster* Mr. *Derham's* thermometer, whose freezing point was about 84, had been very seldom below 100 all that winter, and especially in *November*.

Mr. *Derham* has given this account of the proceeding disposition of the year, particularly as to wet and warmth; because, he is of opinion, that these had a great influence on the following storm; not only in causing a repletion of vapours in the atmosphere, but also in raising such nitro-sulphureous or other heterogeneous matter, which when mix'd together might make a sort of explosion, like fir'd gun-powder, in the atmosphere; from which explosion, Mr. *Derham* judged, that those coruscations or flashes in the storm proceeded, which most people, as well as himself, had observ'd, and which some suppos'd to be lightning.

On *Thursday Nov. the 25th*, in the morning there was a small rain, the winds were high in the afternoon, being at S. E. and S; in the evening there was lightning; and between 9 and 10 o'clock at night, there was a violent but short storm of wind, and much rain at *Upminster*, and a great deal of hail

in some other places; next morning the wind was S. S. W. and high all day; and so it continu'd till about 12 at night, when the storm awak'd Mr. *Derham*, which gradually increas'd till near three that morning; and from thence till seven it continu'd with the greatest violence, and then it began to abate slowly, and the mercury rose swiftly; at half an hour after 12, he found the barometer at 28, 72, where it continu'd till about six next morning; so that it was got to 82 about eight o'clock, as in the following table.

How the wind fate during the storm, he could not positively say, it being exceeding dark all the while, and his vane blown down; but he supposes it to have blown about S. W. by S; or nearer to the S. in the beginning, and to have veer'd about towards the W. about the latter end of the storm, as far as W. S. W. the degrees of the wind's strength not being measurable but by guess, he determin'd thus, with respect to other storms; on Feb. 7, 169⁵, there was a terrible storm that did much damage; this he reckons 10 degrees, the wind being then W. N. W; another remarkable storm was Feb. 3, 170⁴, at which time there was the greatest descent of the mercury ever known; this he reckons nine degrees; but this in November, he computes at least at 15 degrees: As to November 17th (on which Mr. *Townley* mentions there was a violent storm in *Oxfordshire*) it was a stormy afternoon at *Upminster*, accompanied with rain, but not violent, nor was the mercury very low; November the 11th and 12th had higher winds and more rain, and the mercury was lower than even in the storm of November 26th: Mr. *Derham* had accounts of the violence of this storm at *Norwich*, *Beccles*, *Sudbury*, *Colchester*, *Rockford*, and several other intermediate places.

A Table shewing the Height of the Mercury in the Barometer, at *Townley* and *Upminster*, before, in, and after the Storm.

Townley			Upminster		
Day	Hour	Height of Mer.	Day	Hour	Height of Mer.
Nov.	7	28,98	Nov.	8	29,56
25	3	,64	25	12	,39
	9 $\frac{1}{2}$	,61		9	,14
26	7	,80	26	8	,33
	3	,70		12	,28
	9 $\frac{1}{2}$	,47		9	,10
				12 $\frac{1}{2}$	28,72
27	7	,50	27	7 $\frac{1}{2}$	,82
	3	,81		12	29,31
	9 $\frac{1}{2}$	,95		9	,42
28	7	29,34	28	8	,65
	3	,62		12	,83
	9	,84		9	30,07
29	7	,88	29	8	,25

Mr. *Derham* receiv'd an account from a clergyman at *Lewes* in *Sussex*, not only that the storm had made great desolations thereabouts, but that a physician, travelling soon after the storm to *Tisbury*, about 20 miles from *Lewes*, and as many from the sea, had pluck'd some tops of hedges, and chewing them he found them salt; and some at *Lewes* tasting grapes that were still on the vines, they had also the same relish; the grass on the downs in his parish was so salt, that the sheep would not feed in the morning, till hunger compell'd them; and afterwards they drank plentifully, as the shepherds reported; this the clergyman attributed to saline particles driven from the sea; he also heard, that people about *Portsmouth* had been much annoy'd with sulphureous fumes, complaining they were almost suffocated therewith.

One Mr. *Fuller* gives an account that the country people in *Sussex*, tho' about 10 miles off the sea in a direct line, could scarcely be perswaded, but that the sea-water was blown thus far; or that, during the storm, the rain was salt, for all the twigs of the trees the following day were white, and tasted very salt, as he was inform'd; and that not only upon the hill where he liv'd facing the sea, but in all other places within 14 or 15 miles of the sea, as well in the valleys, between which and

and the sea are several high hills, as also on the hills themselves.

Observations on the same Storm; by M. Leewenhoeck. Phil. Trans. N° 289. p. 1535.

ON the 8th of December 1703 N. S. we had a dreadful storm from the S. W. infomuch, that the water mixing with small particles of chalk and stone, was so dash'd against the glass-windows, that several of them were darken'd thereby; the lower windows of M. *Leewenhoeck's* house, notwithstanding they look'd to the N. E. and so stood from the wind, were so cover'd with the particles of the water, which the whirl-wind cast against them, that in less than half an hour's time they lost most of their transparency; supposing this might be sea-water, he view'd the particles with his microscope, and he found they had the figure of our common salt; as to the upper windows, where the rain had beat against them, there was little or no salt to be found sticking on them; during the said storm, and about eight o'clock in the morning, casting his eye on his barometer, he observ'd, that he had never seen the mercury stand so low; but half an hour after, it began to rise, tho' the storm had not been at all abated, at least to any appearance; from whence he concluded, that the storm would not last long, which accordingly happen'd; some suppos'd that the scattering of this salt water would do a great deal of harm to the fruits of the earth; but M. *Leewenhoeck* was of opinion that a little salt spread over the surface of the earth, especially where it is heavy clay-ground, renders it fruitful; and so it would be, if sea-sand were made use of to the same purpose.

The Figures of Sand, by the Same. Phil. Trans. N° 289. P. 1537.

M. *Leewenhoeck* formerly affirm'd of sand, that one can not find in any quantity whatsoever two particles thereof, that are entirely similar; and tho' perhaps, in their first configuration, they might have been so, yet at present, they are exceeding different; especially, the sand we make use of, is obnoxious to such great alterations, that it would be a wonder, if even in its minutest particles, of which there may be 1000 in one small grain, there should be an exact similitude; for let us conclude that our common sand, of which one grain differs from another in pellucidity, was at first form'd with

smooth sides and sharp points, both these are so rubbed the one against the other, that several small pits or holes may be perceived therein, whereby they lose their first figure; and who can conceive what changes those particles of sand undergo, that lie next the superficies of the terrestrial globe; especially, such as lie at some depth under a stony ground, where laden waggons often pass; for these particles of sand, by frequent compressions and collisions, indent holes in each others sides, and break off their sharp points, or angles; not to mention, what alterations are made in these small bodies by storms, thunder, earthquakes, &c.

M. *Leeuwenhoeck* got some shining sand, which tho' very fine, was not transparent; its lustre being entirely occasioned by the reflection of the light from its polished sides; several particles of the said sand, which were much bigger than the rest, reflected no light, tho' they seemed smooth to the naked eye; from whence he concluded, that they had lost their glittering by the frequent friction of their sides against each other; when he had viewed several grains of the above sand with his microscope, he was surpris'd to see, that a great number of them were hexangular, even after sifting the finest from the coarsest; nor could he observe, that any of the sands were similar; he viewed the said sand several times with great attention, supposing, that by some earthquake or other, it might have been thrown up from the place where it had lain at rest, to the superficies of the earth; and several grains appeared to him to have preserved their original shape and figure; for they had received little or no damage, especially the small ones; several of which had such points and sides, that no polished diamond could equal their beauty: He infused some of this sand in *Aqua fortis*, to try whether it would dissolve them, or deprive them of their shining quality; and tho' it lay in the said water several days, he could not perceive any alteration therein; moreover he tried the said sand with so brisk a fire as was capable of melting silver, and yet it did not affect either its figure or lustre.

Plate IX. Fig. 1. A B C D E F represents an hexangular grain of sand, (being exceeding small, and not unlike white scouring sand) that was as bright and shining as any polished metal; and the triangular figures which appeared thereon, were as bright as the rest of the body, which occasioned a very agreeable sight.

Before one of his glasses he placed another grain of sand, less than the former, but it was flat, and he supposed that it was not a 16th part so big as a coarse grain picked out of our common white sand; and this was a surprizing sight; in the said sand,

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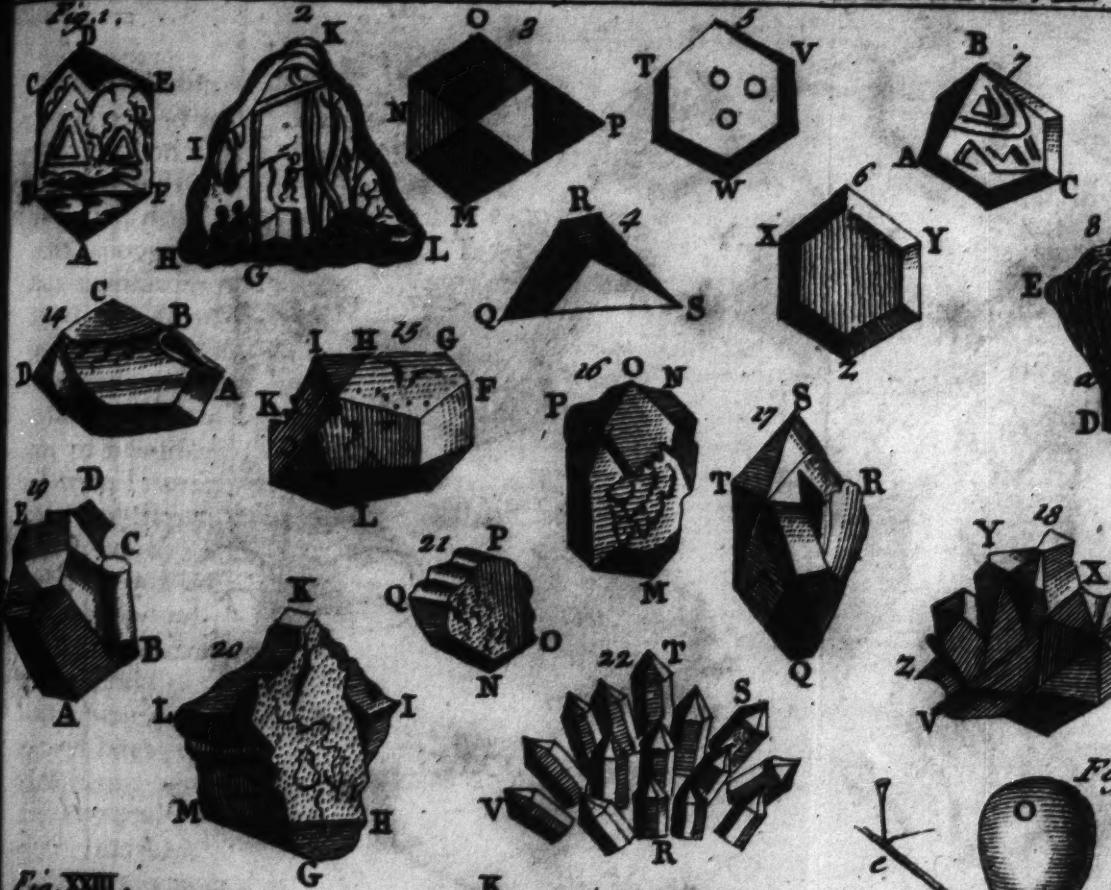
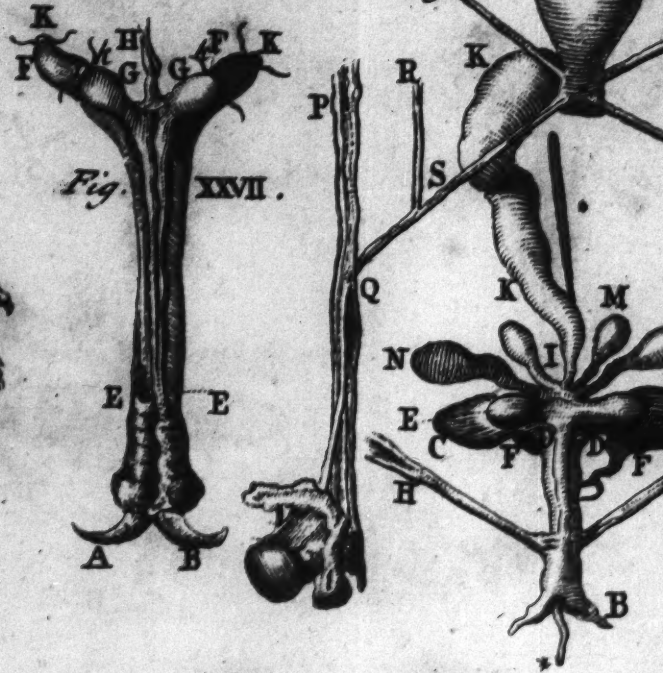
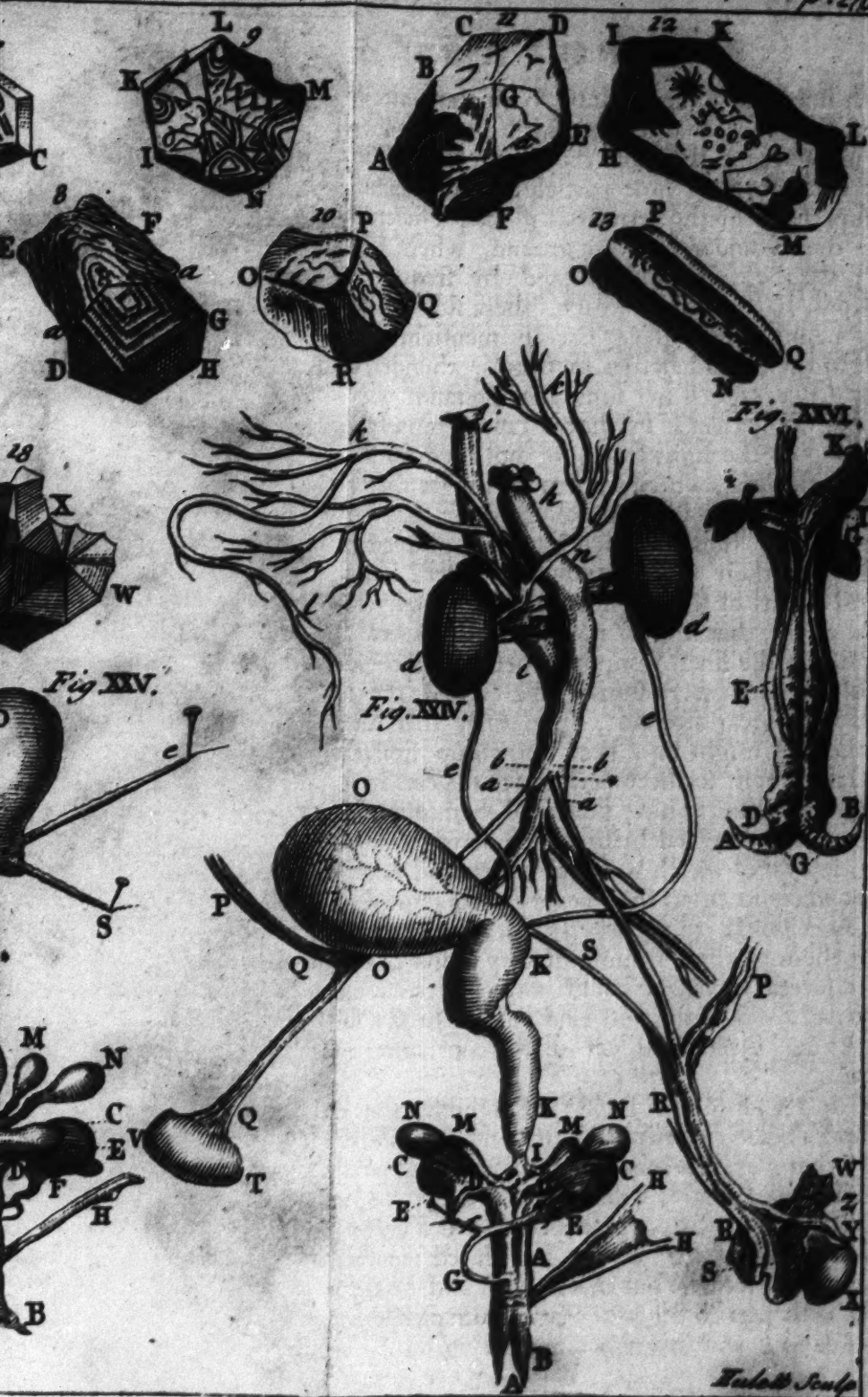


Fig. XIII.



Fig. XXVII.





represented by GHIKL Fig. 2. you may see not only as it were a ruined temple, but in its angle GHI appear two images of a human shape, kneeling and extending their arms towards an altar, that seems to stand at a small distance from them; this was still the more agreeable, because it was as bright as any polished steel.

Fig. 3. MNOP represents (as near as could be traced) another small hexangular grain of sand, with two sharp points like pyramids, and each side that composed the said points were very smooth and shining; M. *Leeuwenhoeck* has seen several such grains of sand, which had on each side a smooth, shining, and oblique superficies; insomuch, that upon one single grain he has reckoned 24 such polished sides or faces; he has also observed several small grains of sand, that, instead of terminating their six sides in a sharp point, ended sometimes in a triangle, quadrangle, and even in a pentagonal or hexangular shining flatness; he observed several three-sided grains, of which some were regular triangles, which were very shining and very thin, and others were thicker, as represented in QRS Fig. 4.

There were other grains of sand that were complete hexangles, the flat sides of which appeared like a steel looking-glass in a frame, and in some of them were little holes, which seemed likewise hexangular; whence he concluded, that such a hole was made from the pressure of another sand of the like figure, as represented in Fig. 5. TVW; when he viewed any of these sands sideways, each of the six sides, which in the figure appear like a frame or border, seemed to be a polish'd looking-glass.

Fig. 6. XYZ does also represent an hexangular sand, opposed to the sight a little sideways, whereby the reflexion is not so full and large, as if the flat side were placed directly before the eye; but then, it came from the two sides, which represent a part of the frame, and are shewn in this figure by X; now, when the hinder part of such a sand is brought before the sight, he observ'd that it had the same figure; and that then, that part of it which should be represented as a dark circle of the shining sand, consisted of 12 bright, oval, flat superficies.

Fig. 7. ABC represents another hexangular sand, whose bright superficies or area was of a different make from its circumference; for, there appeared in the middle of them several triangular figures, which tho' somewhat raised and imbossed, were very bright, and withal afforded a pleasant sight; and tho' the cir-

circumference in this position appeared very dark, yet its sides, when exposed to view, were no less bright and shining.

Fig. 8. DEFGH represents another grain of sand, with its protuberant parts and their respective sides: M. *Leeuwenhoeck* turned the opposite side of the said sand to his glass, whereby he discovered its several shining angles, as represented in Fig. 9. IKLM; he placed, before his glass, another small shining grain of sand, which appeared as in Fig. 10. OPQR, several of whose sides were unblemished; and should he enter upon a strict examination of every one of the grains of sand, he does not doubt, but he would discover each of them to be of a different size and figure, besides several other particularities, which might be peculiar to each; as the great rent or breach, which is represented in Fig. 8. by *aa*; he also observed, that this shining sand weigh'd twice as heavy as our common scouring sand; now, upon his taking some of the pellucid or transparent sand (which did not shine, because it reflected no light) he observed that the sides and angles of each grain were freer from scars and blemishes, than most others he had hitherto consider'd; from whence he concluded, that such sand had not lain long near the surface of the earth.

He placed one of these sands before a microscope, so as to have a full view of three of the four oblique sides, as represented in Fig. 11. by ABCDEFG; one of the flat sides by BCDG; another by DEAG, which had a streak or scratch therein, supposed to be done by the pressure of another grain of sand upon it; and the third flat side by BG *ab*.

Fig. 12. HIKLM represents this transparent sand in its full length, together with the streaks or little holes therein, which M. *Leeuwenhoeck* firmly concluded to be occasioned by the collision of other sands; he likewise observed some, but very few, sands that were long and slender, which appeared thro' a common microscope no bigger than a single hair of a person's beard does to the naked eye.

M. *Leeuwenhoeck* took several of the shining sands and broke them to pieces; and then viewing the broken pieces thro' a microscope, he observed that several of those small particles, tho' 1000 times less than a grain of common sand, had a lustre when the light fell upon them; and that several such particles, and some that were larger, if view'd against the light, represented a fine blooming red; but some of them were so but in part; from whence he concluded, that that part which was not red was thicker than

than the rest, and so did not admit of light thro' it; amongst these small broken pieces of sand, he observed some that had six sides, and others that were triangular; all which are to be considered as common sand; he took one of the abovementioned long slender sands, which he judged to be one of the thickest, and placing it before a microscope, it appeared as represented in N O P Q. Fig. 13; wherein may be distinctly perceived four flat sides; he also observed in several sands, that their bodies consisted of unspeakably thin scales or scaly particles: Among these shining sands he discover'd others that had no lustre at all, nor any of their particles that were broken to pieces; only it appeared to be a dark red matter; and in other broken particles there was not only a red matter, but even a 100 shining particles, all proceeding from one grain of sand; he had also seen some sands, that in the middle of their shining sides represented small figures, that gave no lustre; but upon viewing them more narrowly, he found it was a red matter, incorporated as it were, in the sand; several sands of the coarsest sort, which he had placed before a microscope, seemed to represent an agreeable rock of stone, and another a deep cavern; these last sands were not as M. *Leewenboeck* supposes, so shaped from the beginning, but these cavities and protuberances were owing to various chances and accidents; as by the collision of other particles of sand bigger than these, which likewise in their turns were again broken by other bodies of a larger size, such as pebble-stones, &c. he divided some grains of sand in two, and therein he discover'd figures of triangles.

Soon after the cathedral church at *Utrecht* was almost ruin'd by a dreadful storm in 1704, M. *Leewenboeck* took some of the red stone (whereof several of the pedestals, as also some tomb-stones were compos'd) and viewing it with his microscope; that sort of stone then appear'd to him to consist for the most part of large and transparent grains of sand; and that the redness of the stone was only caus'd by a certain red matter, which had produced such a continuity or adhesion in the mass of the sand, as to be able to consolidate it into a red stone; being of this opinion, he gently separated several sand-particles from the little piece of red stone; and because the red matter which adher'd to some of the sands more than to others, hinder'd him from taking a distinct and clear view of each particular grain, he put some of them into *Aqua-fortis*, to try whether that would dissolve the red matter, and restore its lustre to the sand; but to no purpose; for that *Menstruum* could not separate them; then he took several

several of those particles of sand, that were least surrounded with such red matter, and placing them before the microscope, he observed that some of them had 10 or more sharp points or protuberances, so neatly and regularly fashion'd, that no polish'd diamond could out-do them; he set one of the largest grains of sand before his glass, and therein he could perceive, and that too in a very small compass, seven neat prominent points (exceeding each other in length and bigness) issuing out from very smooth sides; and he judg'd that one such sand was furnish'd with above 100 flat sides, which were very smooth, and consequently very shining, tho' one could not discover with the naked eye any discernible brightness; the reason of which he supposes to be, that this sand being partly transparent, admitted the light thro' its pores, but did not reflect it back like the shining sands; upon his viewing never so many of these sands, he found each of a different figure; and when he pick'd any out that were somewhat oblong, he seldom fail'd to discover at their extremities a four or five sided obtuse point, so neat and regular, as if it had been polish'd; upon breaking to pieces several grains of sand upon a clean glass, he found that they were not near so strong as the shining sand; and having placed the small particles of such a broken grain of sand before his microscope, some of them appear'd like whole sands with their sides and angles entire, all which was a very agreeable sight.

Fig. 14. A B C D E represents thro' a microscope, one of the above-mention'd grains of sand, several of which together compose the red stone; A B C D shews the points which are much more plainly seen, than several others that cannot be distinguish'd, because of their different positions.

Fig. 15. shews another sand, which likewise has several points, tho' not so obvious as the former; because they do not stand so far outwards.

Fig. 16. M N O P represents the last mention'd sand in another position.

Fig. 17. Q R S T also shews a sand of the aforesaid stone, in which the diamond is better cut than in the former.

Fig. 18. V W X Y Z represents two grains of sand, that were still join'd to each other; the one is shewn by V W X, wherein you may observe several points, and particularly between W and X; and the other is represented by X Y Z, and most of its points lie between Y and Z; now as some of the smooth sides of these sands were large, and others small, and that all of them were not so smooth as polish'd glass, and had several small scratches

scratches or flits, he supposes that might happen by the breaking asunder of these sandy particles from each other; that piece of the red stone that still remain'd entire was about the bigness of a pea, and when he beat it to pieces there flew a spark of fire out of it; he made a small bit of it glowing hot, and so he let it drop into water, supposing that not only the particles of sand would be separated thereby, but that the red matter which consolidated the sand would also be divided from it; but he found that the sands only were separated from each other, and each particle thereof was as strong as if it had never been in the fire, and also surrounded with the red matter; but in some of them, which had assum'd a greater transparency than before, he could plainly discover, that each particular grain consisted, or rather was a congeries of several small particles, of which you could see in some grains, 50 such, standing out like pointed pyramids all transparent, and some of them had the same figure as the grain of sand itself had: By these observations he was fully satisfied, that the sands of which the above-mention'd red stone was compos'd, had for the most part preserv'd their original figure, and that they were so hard and solid, that their falling one upon another could not produce any adhesion, otherwise than by the intervention of that red matter, which was interspers'd, and mix'd therewith.

From these observations M. *Leeuwenhoeck* was naturally led to consider diamonds; and his hypothesis is, that all the diamonds that have or shall be discover'd, do not grow, nor are made in any series of time, but were form'd like other sands, at the beginning of the world; for how is it possible that such a pellucid body can be produced in the bowels of the earth, by a congealing or coagulated *Succus* or moisture; and if it were so, why don't we meet with very large diamonds? For when a small diamond is once form'd, there would be a more than ordinary conflux of the same plastic matter thereto; as we find in other things, where substances have a strong tendency or inclination to those of a homogeneous nature with themselves: M. *Leeuwenhoeck* has been assur'd, that in some places, water filtrates thro' the rocks into the subterraneous caverns, and coagulates at the top of those vaults into icicles, and at last are really petrified; we may allow this to be true; and further, were these icicles (which he looks upon to be nothing else but a petrified salt) to be observ'd with a microscope, and compar'd with the same particles of the rock, from whence the above-mention'd filtration proceeds, he makes no manner of doubt, but that these icicles would be

found to differ from the other; to be satisfied in his above-mention'd observations, he took a piece of white marble brought from *Italy*, which was of two sorts; the one was strong, and the other light and very brittle; he broke the brittle marble as gently as he could, that the configuration of the small particles might not be much alter'd; and having view'd several of them with his glass, he saw abundance of surprising particles, which may justly be stil'd sands with their regular sides and angles; and several of them were of the same figure with the shining sand; but not being satisfied with this hypothesis; viz. that the above-mention'd particles were originally nothing else but sand-particles, with their angles and smooth sides; and that at the time of their coalition or falling upon each other, they were all soft and flexible, and thereby were so rivetted and join'd together, as to become one solid body, which we call marble; and that consequently, the said particles did for the most part change their figure, and assume another form, proportionable to the solidity of their coalition; and that some of them had still preserv'd those smooth sides and angles, which they had at the time of their coalition; which sides and angles represent the points that are found in diamonds; and that in one particle of sand you might discover three, and in another seven neat and regular points: From these observations, M. *Leeuwenhoeck* suppos'd, that almost all the sand of the whole earth has preserv'd the figure given it at the creation, and that the particles thereof, before they happen'd to collide or fall upon others, were compos'd of such hard bodies, that they could not be join'd to them, and so remain'd what they originally were; only that by their collisions with other bodies, their first figure might be somewhat impair'd; and the nearer they lie to the surface of the earth, the more subject they are to such alterations; when he oppos'd such a diamond-like sand with its point to the sight, he could see its point, but the sides from whence the points arise, were more obvious; and in such a position the sand would appear four, five, or six sided; and not only so, but where two sides join'd, he could also perceive such a point of a diamond-cut standing out.

Fig. 19. A B C D E F represents one of the grains of sand, of which a great number compose the above-mention'd white *Italian* marble, wherein at each of the letters you may see its points or angles.

Fig. 20. G H I K L M shews the second sand and these letters the several points.

Fig. 21. NOPQ is the third sand (which and the two former was separated from each other) wherein there is such a flatness, as is observable in few sands; he also took a little piece of the said marble, whose parts were very close and compact, and making it red hot he dropp'd it into water; in doing which, he observ'd that not only the sand-particles were separated from each other, but some of them were broken off with such violence, that they were thrown out of the water; he took some of this water directly, in order to see what salts were communicated from the stone thereto; and he soon perceiv'd a sort of film or scum over the water, without being able to discover any particles in the said scum, which he suppos'd to consist of coagulated salts; and that there were some such under the scum he had reason to believe, but they were so obscure, that he could not well perceive them, and the more so, because they were hid by the said scum; he then took a large piece of the above-mention'd marble, and heating it red hot, he also dropp'd it into the water; whereupon there came a thicker scum over it, which he let lie upon the water 24 hours, and then breaking it and taking a little of it out, he found it hard and petrified; and placing it before his microscope, to discover (if possible) the figure of those particles, he could not accomplish his intention (tho' he had often repeated the trial) by reason of the smallness of the particles, and their strict union with each other; only a few of them appear'd to him four and six sided, and reflected the light from several parts; others that were bigger, were compos'd some of three, others of four small particles, which we may suppose to be salt ones; several thousands of these small particles lay in a very small compass; which being separated and broken into pieces, M. *Leerwenhoeck* suppos'd that each particle consisted of a great many more, and much minuter ones; and indeed they were so minute, that they almost escap'd his sight thro' the best of his microscopes: He tried some of the said particles in a pretty strong fire, and he found that thereby they lost some of their transparency, and were divided into smaller particles that were quite obscure; after this he took a little of that water, which lay under the superficies of the suppos'd coagulated salts, imagining he should find some salt-particles in the said water; and putting it upon three several clean glasses, he observ'd, that after the space of four hours the water was quite exhal'd, and that there remain'd several 1000 salt-particles out of one single drop of water; which salts were all separated from each other, several of their superficies being very bright, but their sides were

opaque; and he could clearly perceive that some of their superficies were shining, and their figure quadrilateral; the darkness of their sides he suppos'd to be owing to those salts being squares, like dice; between these lay other particles that were much smaller, which he suppos'd to be of the same figure too, but because of their smallness, he could form no certain judgment about them; after that the water which lay very thin was suddenly exhal'd, he saw several salts that were larger than the rest, and more irregular in their figures, but coagulated together, some of them were squares, but not regular; M. *Leeuwenhoeck* took about 10 times as much rain-water, and mixing it with the above-mention'd salt-water, he then observ'd, that the salts were not dissolv'd, but emerg'd to the top; but when he press'd the same salt-particles under water, so as to wet them all over, they subsided to the bottom, where they remain'd, without being dissolv'd, or uniting with the water; now seeing, that the great number of salts extracted from the aforesaid marble are of so obstinate and tenacious a figure, that nothing but fire can divide them, and that they are such inflexible bodies, that they cannot be dissolv'd in water; we may well conclude, that the grains of sand, which compose such stones, were not only soft at the time of their coalition, or union with each other, but that also at the same time, there interven'd a very inflexible fix'd salt, instead of mortar, between the particles of sand; unless you chuse to say, that each particle of salt does in some degree consist of such fix'd salts.

After this he took a piece of hearth-stone, call'd *Bentheimer*-stone, because found in quarries in the county of *Benthem*; this stone was so soft, that he could easily crumble it between his fingers; and afterwards viewing it with one of his glasses, he could perceive nothing but particles of sand, without the least smooth side, or regular angle; and moreover, it appear'd to him, that this sand had acquir'd a sort of conglutination, or was grown into a solid substance, which we call stone, a long time after it had been nothing else but sand, and its particles had been worn and collided against each other; his reason for this is, because the sides of every grain of this sand, that had been lately stone, were as full of small holes and breaches as any sand he ever saw; and in viewing them, a person would imagine that they were compos'd of thousands of smaller particles; and that some of them were of a triangular, others of an exact flat quadrangular figure; and when M. *Leeuwenhoeck* observ'd these sands at rest, he judg'd that the original shape of several of them were hex-
angular

angular, and several pointed like diamonds; and those points issu'd out from smooth flat sides: He took a little bit of the said *Bentbemer-stone*, which was very hard, and wrapping it up in paper, he broke it to pieces with a little hammer, but he could observe no other difference between the former sand and this; only that the particles of the last were much smaller; he also took a piece of an alabaster-stone, and having view'd it several times, he observ'd after breaking or beating it very small, that the little particles were very thin and transparent, and their figure a flat oblong square, with two acute and two obtuse angles; and tho' he saw amongst them some others that were not quite so regular, yet he suppos'd, that the exactness and regularity of their figures had been lost in the violent separating them from each other; the above-mention'd particles were for the most part so exceeding small, that they could hardly be seen thro' his best microscope; but some of them (whose figure being larger, he could more easily discern) appear'd to be compos'd of very thin particles lying upon each other; now upon viewing those particles of the stone, that were as big as grains of sand, he found that each of them was compos'd of several thousands of smaller particles, whose shape he could not discover; and when he made a little bit of the said stone red hot, and dropp'd it into water, it dissolv'd into a white substance, as fine as meal or flower, and thereby it lost all its transparency; and each particle, tho' its figure had been an oblong square, was now compos'd of such small particles, that it was impossible to perceive what shape it had; after this he took another little piece of mineral-stone (the 100 weight of which contains near 50 guilders of silver and 30 of gold) brought hither from *Sumatra*, about the bigness of a common bean, and putting it over a pretty smart fire; the sulphur, of which there was a great deal in the mineral, stood in bubbles, and remain'd upon the stone in the shape of round, black, burnt globules; then he dropp'd it red hot into water, where it remain'd whole, only with this difference, that whereas before it was very hard, now it became very brittle; and having broken it to pieces, he perceiv'd that it chiefly consisted of irregular particles, tho' some few were of an exact diamond-cut; and he could see much more plainly than before, the globules of gold and silver lying separate from each other; but some of the former were so exceeding minute, that they almost escap'd his sight thro' the microscope; and forasmuch, as gold is not near so easy to be melted as silver, he saw some that the fire had not force enough to reduce to globules, and upon it there lay a small globule of
lver,

silver, which the fire had reduced into that figure; and tho' the gold and silver touch'd each other, yet they were not united, because the fire where that gold lay was not strong enough to put it into fusion: M. *Leewenboeck* had often observ'd in these mineral stones, that one part of them was of a white, and another part a little lower in the same stone was of a dark grey colour; and that they are brought hither in little pieces, the biggest of which does not exceed a joint of one's finger; and that in some few pieces there were little cavities or breaches, wherein he never met with any metal, either gold or silver (for in that mineral there is no other) but oftentimes with very small crystals, which M. *Leewenboeck* calls so, from the analogy of their figures with those of rock-crystal, being transparent, hexangular and ending in a point or spire like them; these crystals were in the white part of the stone, but those that were in the grey part were not pellucid.

Fig. 22. R S T V represents a small particle of such crystal, clear and transparent.

Some are apt to believe that these crystals are form'd by the exhaling damps or moisture in those mines, from whence the mineral stone is dug; but M. *Leewenboeck* does not think so; for upon that hypothesis, the whole cavities should be filled with the particles; whereas we find the contrary; for he had observed, that not a fourth part of the cavities is filled therewith; and he had found some of the said crystals in such little cavities, that a small pin would have filled them, and that also in breaches of the mineral stone, that were not so broad as the thickness of a small pin; whereas, he could meet with none of these crystals in other cavities that were much larger; M. *Leewenboeck* rather supposes, that most of the stony matter where those cavities are found, was of the same configuration with the said crystals; and at the same time that the particles of stone coalesced or united, the intercepted air occasioned some cavities, in which the crystals were shut up, and in which they acquired the figure which they now retain; in the mean time the other parts about these cavities were so firmly united, as to become a hard and solid stone: Before M. *Leewenboeck* had considered the conjunction of the particles of divers stones, he supposed, that these particles were united to each other by such a sort of fixed salt, that nothing but fire could separate; but he was afterwards convinced, that this supposition would not hold in all stones.

An Account of an Earthquake in the North of England; by Mr. Thoresby. Phil. Transf. N° 289. p. 1555.

THERE was an earthquake felt at *Hull* upon the 28th of *December*, 1703, about three or four minutes after five in the evening; it heav'd up chairs and tables and made pewter-dishes and the windows rattle, shook whole houses, and threw down part of a chimney; the shock came and went suddenly, and was attended with a noise like wind, tho' there was then a perfect calm; it was felt in much the same manner at *Beverly* and other places, and particularly at *South Dalton*; it was more violent near *Lincoln*, where it heav'd up the chairs people sat on, &c. It was felt pretty much at *Selby*, as also near *Navenby*; the sudden noise of which seemed to be like the rumbling of two or three coaches driven furiously, and it shook the chairs on which people sat; and even the very stones were seen to move; a little before, there was a violent storm; and at *Leeds* there was a much greater storm the preceeding night and next day, than was in the south parts of *England*, of which there is an account in this *Transaction*.

An Account of a Calenture; by Dr. William Oliver. Phil. Transf. N° 290. p. 1562.

IN the month of *August* 1693, the Dr. was called upon to see a sailor on board a man of war, in a violent calenture; the patient was between 30 and 40 years of age, brown hair'd, pretty tall, but thin; when the Dr. saw him first, he found him in the hands of three or four of his comrades, who were hardly able to manage him, because of his constant struggling to get from them; the Dr. observed, he cried out very often, *that he would go into the green fields*; he had a furious and wild look, and every now and then he would heartily curse such as held him; the Dr. first of all felt the patient's pulse, which he found to be only a disorderly motion of the blood in the artery; and he had also a burning fiery heat all over his body, but he could perceive no distinction, or vibration of pulse at all; the surgeon of the ship had, before the Dr. came, attempted to bleed him; but tho' the vein of the arm was fairly open'd, yet he could not procure an ounce of blood from thence; upon that the Dr. order'd the surgeon to open the frontal vein, which succeeded no better, for that soon stopped too; this put the Dr. upon trying a third time, what effects the opening the jugular vein might have; from this vein, tho' the orifice was pretty large,

large, be had about two ounces of florid thick blood, and then it quite stopp'd there too; upon which the Dr. ordered the surgeon to untie his arm, and he bled again at that orifice, but in a small quantity, and then it stopp'd as before; however, having three orifices open at that time, they drew blood sometimes from one, and sometimes from the other, where they saw it run most freely; after several essays of this kind, the Dr. always observed, as the vessels emptied, the patient bled more freely, and at last as fast as he desired: Now the Dr. was all along of opinion, that he ought to continue bleeding, till he saw some visible alterations, and consequently abatements of his symptoms; which happen'd in about half an hour's time after the Dr. saw the patient; and upon feeling his pulse again, it now began to beat distinctly, but very quick; not long after this, (for now he had bled well enough) the Dr. observed that his strugglings were not so strong, that his ravings and crying after green fields ceased, his wild looks were much abated, and not only his pulse recover'd its due and regular vibrations, but that the burning heat was moderated too, and the fury of his spirits laid to that degree, that now one man could easily manage him as he pleased; in this half hour there was taken from him about 50 ounces of blood, from the said three orifices; by this time the Dr. order'd the patient to his hammock, after securing the orifices from bleeding again, and directing the surgeon to give him an ounce of *Diacodium* in a draught of barley-water, as he went into it; upon this he slept 'till about noon, when he awaked, with no other complaint, but of weakness from the loss of blood, and a soreness all over his body, occasion'd as the Dr. supposes, from his violent convulsions, and endeavours to get loose: This was the only calenture the Dr. saw for three years he was in the fleet, two summers of which he was in the *Mediterranean*, and this happened in the *Bay of Biscay*, in the latitude of 47, in the month of *August*: The Dr. was informed that they are more frequent in warmer climates, tho' very often undiscover'd; the reason of which he supposes to be this, when they are seiz'd with this violent heat and disorder, which generally happens in the night, the patients steal privately over-board into the sea, imagining that they are going into the green fields; for the Dr. has frequently heard in the *Mediterranean*, in summer time and very hot weather, of sailors lost in the night, which the crew took for granted were gone off, upon such like occasions, unobserved; and this very patient was actually going over-board, when one of his companions,

panions, who had suspected his design, caught hold of him just as he was going to leap off, and calling for help, secured him by this accident.

This distemper, the Dr. is of opinion, is what we call a *Phrenitis*, occasioned by a more than ordinary effervescence and heat of the blood; which distracting and confounding, if not inflaming the animal spirits, the proper and immediate ministers of the mind, is the cause of all those irregular motions, violent explosions and convulsions; and hence it is, that the animal ideas are confused, the imagination depraved, and all the rational functions disorder'd; from these orgasms in the animal spirits we may, the Dr. supposes, give some account of the want of pulse too, their constant and impetuous motions thro' the fibres, not admitting any distinct arterial vibrations; and perhaps, phlebotomy did not succeed at first, because the orifices contracting presently, prevented an effusion, to which probably, the thickness of the blood contributed not a little; the patient's calling out for the green fields (the true criterion of this disorder) the Dr. takes to be owing to the violent heat he was then in, which made him fancy green fields and open air to cool himself in at that time, the ship being too warm for him under these circumstances for want of air; and lastly, calentures happen oftner by night than by day, because our ships are closely shut up by night, and are less airy than they are in the day-time.

A new Division of terrestrial Animals, with Observations on the Opossum; by Dr. Tyson. Phil. Transl. N^o 290. p. 1565.

DR. Tyson upon dissection having observed the *Penis* of the opossum to be fleshy, and to have no bone therein, finds it cannot be referr'd to the dog or weasel kind, as some have thought; and what *Piso* means by his *Glires majores montani*, to which he refers it, the Dr. does not here enquire; yet still it must be acknowledged that we cannot be at any certainty in this matter, unless we had a more perfect numeration and description of the several sorts of animals that are in the world; and by a strict enquiry into their inward, as well as outward parts, had observed, how gradually they differ from each other, by easy and gentle steps, the intermediate species linking the whole together; however, 'till this can be attain'd, the Dr. thinks every little help will contribute somewhat; and there-

fore, he here proposes a division of such terrestrial animals as have several divided claws and nails, into

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|--------------------|---|
| <i>Animalia.</i> { | <i>Χειρο-δακτυλα seu manu-digitata</i> , i. e. whose feet resemble hands, and have fingers rather than toes. |
| | <i>Ποδο-δακτυλα seu pede-digitata</i> , i. e. whose <i>Digiti</i> , from the order of their position and from their shortness, as also their uses, resemble toes more than fingers. |

For tho' our language makes a sufficient distinction between them, by calling the one fingers and the other toes, yet the Greek and Latin languages do not; for *δακτυλοι* and *Digiti* signify both those on the hand, and those on the feet likewise; to discriminate them, therefore they are obliged to add another word, as *Digitus Manûs*, or *Digitus Pedis*; which sufficiently justifies our distinction of *Χειρο-δακτυλα*, and *Ποδο-δακτυλα*: Now we may observe these differences between the fingers and toes; viz. that the fingers are much longer, having usually a thumb set at a distance from the range of the other fingers; and they are thus contrived, for the better holding what they have a mind to; and especially in these animals, to assist them in climbing trees, &c. for catching their prey; whereas the toes are shorter, and are set in a more even range together, and better contrived for swift running, by which way this other sort of animals take their prey; this latter sort the Dr. does not insist on here, but rather gives a subdivision of the former; viz. such animals as have their feet formed like hands; now, where there is a thumb, tho' we may esteem the hand there more perfect, yet the Dr. finds it is not always necessary; for in several animals it is wanting, as will appear by the following scheme, which he proposes only as an essay or hint, that may be further enlarged or amended.

Animalia Xειρ-δακτυλα, quorum

omnes sunt manu-formes seu animalia quadru-mana

cum pollice in omni pede; viz.

*Simia } caudata
Romack } non caudata
Coati Brasil, &c.*

sine pollice in pedibus

Pedes

anterioribus

*Vantrevan
Sciurus
Mus, &c.*

posterioribus

Genus felinum

duo tantum sunt manu-formes; viz. vel

anteriores

cum pollice

Mantegar, &c.

sine pollice

*Cuandu Brasil Margravii
Tlaquatzin spinosum Hernandez
Hyftrix
Tamandua Brasil, &c.*

posteriores

cum pollice

Carigueya S. Opossum, &c.

sine pollice

Under the first member of this division Dr. *Tyson* includes the ape and monkey-kind, which in his discourse of the *Ourang Outang*, ought rather to be reckoned a four handed than a four footed animal; and considering how large a species of animals may be reduced under the quadru-manous kind, agreeing in this, tho' differing in other particulars, he assigns them a general class, to be afterwards subdivided, according to the gradual differences they have from each other; he, therefore, reduces under this head the *Romack*, tho' differing much from the monkey-kind, both in the head and face, as being quadru-manous, and as having a thumb on each hand; whether it is described by any, or what other names it is called by, the Dr. does not know; and because, in its face and head it so much resembles a fox, and in the rest of its body a monkey, he calls it *Αλωπη-Πιθηκ*, *Vulpi-simia*, or the fox-monkey; the next

mentioned in this class; viz. the *Coati* of *Brasil* and *Virginia*, or the *Rackoon* or *Rattoon*, tho' it does not resemble the monkey-kind in its body, yet because it has hands like a monkey, as *Margrave* tells us, the Dr. likewise places it here; as may all others, whose feet are formed like hands, and have a thumb on each; for there are some that have no thumb on their fore-feet, and others have none on the hinder feet; in the number of the former may be reckon'd the *Vantrevan*, the squirrel and mouse-kinds, or any others that may be observed to have all their feet formed like hands, only that their fore-feet want a thumb; the *Vantrevan* (as it was called by the person who shewed it in *London*) altogether resembles a monkey; on the fore-feet it had only four long fingers and no thumb; it is a beautiful creature, very brisk and nimble in motion, and likewise kind; it has a very long tail, by which it suspends its body as the *Opossum* does; the squirrel-kind have on their fore-feet four long fingers, on the hinder-feet five, and one like a thumb; it makes use of its fore-feet like hands, in holding up its food to its mouth, and lives on trees as monkeys do; but the affinity between the monkey and the squirrel-kinds, does better appear by some monkeys the Dr. had seen, which have a large thick furr upon the belly, and a thick bushy tail like the squirrel; whereas usually the ape and monkey are thinner of hair on the belly, and that on their tail is shorter; this sort of monkey the Dr. therefore calls the squirrel-monkey, or *Sciuro-Pithecus*; but as its face is more like a man's or an ape's, as likewise its teeth, in these respects it differs much from the squirrel-kind; the mouse-kind in the shape of its head, the long teeth before, and its large prominent eyes resembles more the squirrel-kind; and it makes use of its fore-feet, as hands in feeding itself, where it has only four fingers without a thumb, but it has five on its hinder-feet, of which the innermost and outermost are placed at a distance from the range of the three middle fingers, like two thumbs, as may be observed in some of the lizzard-kind: Some may question, why we should include the cat-kind in the number of the *Animalia Xero-Saxilua*, since their feet seem rounder, and to have toes rather than fingers; but we may observe, that it uses its fore-feet like hands in climbing and catching its prey; and when it does so, it exerts its claws and lengthens them; but when it uses its feet in going and running, it shortens them, that being most convenient for that purpose; so that it is well provided for both, and its *Digiti* are

are of a middle nature between fingers and toes, as they are lengthen'd or shorten'd; and we may observe, that there is on each fore-foot a *Pollex*, or thumb set at a distance from the range of the other claws, whereby they are more like hands, and on the hinder-feet there are only four *Digiti*, without a thumb.

We come next to those animals that have only two feet formed like hands, and those are either the fore or hinder-feet; those whose fore-feet only are formed like hands, have either a thumb there, as the *Mantegar*, &c. or they have only four fingers, without a thumb, as the *Cuandu*, &c. The *Mantegar* is not described by any author; it is about the bigness of a mastiff-dog; it measured from the extremity of its nose to the *Anus* three foot two inches; the girth of the body was two foot two inches; the head 14 inches long; the forehead five inches broad; the head somewhat resembling that of a horse; the nostrils large; the nose of a deep *Cinnibar* colour, and the bones of the nose are depressed lower than those of the upper-jaw, where the skin was of an azure blue colour; there is a large tuft of hair on the forehead, as also under the chin; the forepart of the body, and the inside of the arms and legs, are almost bare of hair; the hair on the outside of them, is of a mottley brown and olive colour; it is blackish on the back; there were *Mammæ* on the breast; it has an *Umbilicus*; the *Preputium* is without a *Frænum*, as in the ape-kind, of a vermillion colour; the *Scrotum* of an azure colour; it has no tail; it is very fierce, having two long tusks in the upper-jaw, and it is a very lascivious animal; the fore-feet perfectly resemble hands, having long and thick fingers, and a thumb; and all the nails of these fingers are flat; the nail on the hinder toes and fingers, are imbricated, not flat; and tho' the claws are pretty long, and somewhat imitating fingers, yet the thumb is not so perfect; and the whole differs from the fore-feet, when sitting and supporting itself by a stick in one hand, being thus erect, and holding a cup in the other, it would drink and not lap; its food was chiefly fruits: Amongst those animals whose fore-feet are like hands, and have no thumb, the Dr. reckons the porcupine-kind, as the *Cuandu* of *Brasil*, a sort of porcupine described by *Margrave*, and in *Jo. Nieuhoff's Voyages*, p. 18. which has but four fingers on the fore-feet, and five on the hinder ones; therefore as *Margrave* observes, for want of a thumb, it is but slow in climbing trees; but the better to help itself, it twists its tail about a bough, to save it from

from falling; and the *Tlaquatzin spinosum* of *Hernandez* is much like it, if not the same; the common porcupine has likewise four fingers before, and five behind; the *Tamandua* of *Brasil*, or ant-bear, has but four fingers before, where the want of length in the fingers, is supplied by that of the nails, and it has five toes behind; the Dr. has ranged this anomalous animal (as Mr. Ray calls it) here, because he climbs trees, and in so doing, makes use of his tail as some others mentioned here do; and we may likewise bring into the number, the *Ai*, *Ignavus*, or *Sloth*, because it climbs and lives on trees, and has a head not unlike an ape's; and as *Margrave* assures us, two teats on the breast; but it has only three claws on each foot, with very long nails, like the *Tamandua*; and because its feet are very narrow and defective in toes, it is very slow in its motion: In fine, amongst the animals, whose hinder-feet only are like hands, is to be reckon'd the *Carigüeya* or *Opossum*; and if there are any other animals that have their hinder-feet form'd like hands, either with or without a thumb, and have all or several of their claws formed like fingers; and if they climb or live on trees, they may be reduced to the same class of *Animalia Χειρ-δακτυλα*.

Dr. Tyson, in describing the ears of a female *Opossum* in a former *Transaction*, had not an opportunity of observing that white rim that incircles them, which is very beautiful; for when the animal is in health, there runs for the breadth of two lines or more, an edging round the verge of the ear, of a perfect milk-white colour; but this part of the ear being so very thin and tender, it is easily affected by cold or illness, and then this white part becomes jagged and crumpled, as if burnt up, and the whiteness disappears; it is on this account that *Margrave*, in his description of the *Tai-ibi* of *Brasil* (which the Dr. takes to be the male *Opossum*) says, it has *Aures subrotundas, molles, graciles, albas, teneras ut charta*; not that the whole ear was white but only the edges. In the male subject Mr. Cowper dissected, he neither observed the *Marsupium*, or pouch for receiving the young, nor the muscles belonging to it, as has been described in the female *Opossum*, nor did the Dr. in that he dissected; only this he took notice of, when first he had it, that the skin in that place seemed to be looser, so that with his finger he could easily thrust it in, and by turning it round, he could for the present form a pouch, but this would soon turn out again, upon withdrawing his fingers; the Dr. therefore leaves it as a query to be resolved by those that live where

where these animals breed, whether this part of the skin is capable of being formed upon occasion into a pouch or *Marsupium*, and whether they ever observe the male to receive the young ones, as the female does? However, there were in the male *Opossum*, those bones the Dr. calls *Marsupialia*, and he observed muscles running from them to the hinder-legs, which no doubt are very serviceable to them in drawing up their bodies; and this Mr. Cowper had likewise observed: The Dr. further adds, to confirm what Oppian and others he had mentioned in a former *Transaction* write, concerning fishes receiving their young ones into their bellies) that Mr. Herbert, in his *Travels* Lib. 1. p. 23, lays, *That in their voyage they took a shark, nine foot and a half long, and found in her paunch 55 young ones, each a geometrical foot in length, all which, he adds, go out and in at pleasure.*

As to the brain, the Dr. observed that when taken out of the *Cranium*, it weighed two drams two scruples; he did not find, either in the *Cerebrum*, those *Anfractus*, nor in the *Cerebellum* those *Circilli*, which are usually met with in other brains; the whole was of an oblong figure, and seemed to be divided into three parts; viz. the *Cerebellum*, the *Cerebrum*, and that part of the *Cerebrum*, which was projected into the *Rostrum*; for by compressing the *Cranium* here, the fore-part of the *Cerebrum*, from whence issued the *Processus Mammillares*, and olfactory nerves, was remarkably distinguished from the *Cerebrum*, like an anterior brain; the Dr. had likewise observed this in the vermin-kind, and in those animals that have a long *Rostrum*; for nature seems to give them in that place more particularly the advantage of the sense of smelling, either for finding out their prey, or avoiding the danger they may be exposed to; the Dr. also observed the optic nerve, and the eyes, which were large; the auditory nerves were likewise large, to give these animals a quick sense of hearing upon any sudden noise, and so to avoid the danger; it was observed that it saw best in the twilight, and not so well in a bright sun; which the Dr. was readily brought to believe, because it was then to seek out for its prey; the Dr. observed in the eye the *Membrana nictitans*; the *Glandula lacrymalis* was large and oblong; there was the *Musculus septimus suspensorius*; the crystalline humour was large, very transparent and almost of a globular figure; the eye or *Iris* was black.

The Anatomy of those Parts of a male Opossum, that differ from the Female; by Mr. Cowper. Phil. Transf. N° 290. p. 1576.

THIS male *Opossum* was brought from *Virginia*, and kept alive for some time, but falling from its meat it languish'd and died; the cause of its death appeared to be from a mortification of the *Duodenum*, immediately below the *Pylorus*; which seemed to arise from a quantity of hay, that had been collected in the stomach, and matted together, in the shape of the hairy *Tophus* Dr. *Tyson* had found in the stomach of that *Opossum* he dissected in *Phil. Transf. N° 239*, only that Mr. *Cowper* could not find any hair in this; this was of hay slipping out of the stomach, stuck in the *Duodenum*, which together with the viscid matter that involv'd it, entirely obstructed the passage in that gut, as well as that of the gall into the gut, which appear'd from the distension of the liver, as well as from the fullness of the gall-bladder; the *Omentum*, which in this animal is only fastened to the bottom of the stomach, had also suffered a mortification, as had almost the whole intestinal canal.

Besides the organs employed in generation, the male *Opossum* differs externally from the female, there being no *Marsupium* or pouch for receiving the young ones; nor are there any muscles inserted into the skin of the *Abdomen* springing from the *Ossa marsupialia*, as Dr. *Tyson* calls these bones, which may deserve the name of *Hyoides*, from the figure they form with the *Ossa pubis* of this animal; which bones do not seem to differ in the male from those of the female, described and represented in the *Transaction* abovementioned; there is no external appearance of genitals in the male *Opossum* but the *Scrotum*, which is but just large enough to contain the *Testes*; nor could Mr. *Cowper* readily discover any other *Foramen* outwardly in these parts but the *Anus* A, Plate IX. Fig. 23. which leads to the *Rectum*; till upon stretching its sides, he found another *Foramen* B, which on dissection, appeared to be the *Preputium* or out-let of the *Penis*; on compressing the parts on each side of this *Cloaca* A, B, he observed two drops of a yellowish coloured liquor, resembling *Pus*, start out on each side the *Anus* cc, which upon further examination he found to proceed from two glandulous bodies, or bags placed on the *Sphincter* muscle of this part; this sort of liquor was likewise found by Dr. *Tyson* in the pouch of the female; which like this, had more of the peculiar *Fetor* of this animal, than any other part besides; for on removing these parts with the skin about

about the *Cloaca*, Mr. Cowper was freed from the ungrateful smell; and upon separating the skin from the muscles of the *Abdomen*, the two abovementioned bones, (peculiar to this animal) appeared, from whence some muscles arose, and were inserted into the *Ossa femorum*, which performed the office of the *Psoas* muscles, and they were much smaller in this than in other animals; the abdominal muscles were also fastened to the last mentioned bones, particularly the *Recti*, which enabled this animal to project or spring its body, especially in pulling its hinder legs forwards, with greater advantage and force than other animals, which are without these bones; immediately, under the skin about the *Cloaca*, he found a thin fleshy muscle, inclosing the *Præputium* and the lower parts of the *Rectum*, and odoriferous bags, together with the four mucous glands M M N N Fig. 24, 25, at the roof and body of the *Penis* itself A; all which parts were liable to be compressed by the action of this muscle, especially when the *Penis* is erected, whereby its erection is also sustained, by compressing the two external veins on the *Dorsum Penis*; on removing this thin broad *Sphincter* muscle, Mr. Cowper was obliged to clear away two lumps of hard fat, before the body of the *Penis* could be discovered: The *Scrotum* being removed, each testicle appeared as represented on the left side Q T V, Fig. 24; the *Vasa præparantia & deferentia* Q Q, being inclosed in the *Cremaster* muscles P P; those muscles were in proportion very large in this animal, as Mr. Cowper has always observed them in animals that have no *Vesiculæ seminales*, which is the case here; and this provision of nature seems not only necessary to suspend the *Testes*, but these inclosing *Cremasters* also compress the *Epididymides* and *Vasa deferentia*, and oblige them to dispatch their contents (*viz.* the *Semen*) into the *Urethra* in *Coitu*, which otherwise would have a slow progress; but this contrivance appears more peculiarly requisite to this animal, because the deficiency of the *Vesiculæ seminales* here, seems to be supplied by the largeness of the *Epididymides* of the *Testes* W W, Fig. 24, 25, which are their excretory ducts, and appear in this animal to have a larger bore than ordinary; for this reason the *Tunicæ vaginales* are very strait, as in T V R R Fig. 24: On discovering the originations of the spermatric artereries, Mr. Cowper met with an appearance he had never heard of nor observed before, in which he should not have had any satisfaction, if he had not first injected wax into the trunks of the great artery *iii*, and *Vena cava b* Fig. 24. below the *Diaphragm*; in this animal the descending trunk of the great artery below the emulgent

arteries, is placed directly under the trunk of the *Vena cava*; nor do the iliac branches of the arteries here, twine about those of the veins, as in human bodies, and in some quadrupeds, which is done, perhaps to compress the channels of the veins, and by means of the pulsation of these arteries to propel the blood in the veins towards the heart; but that contrivance seems no way necessary in this animal, because the contrary position of its body is more customary in hanging by its tail with its head downwards; it is not unlikely if the veins of this animal had been examined below the heart, but we should meet with some contrivance to prevent the precipitate flux of blood in that pendulous position, as Mr. Cowper has observed in the trunk of the *Cava* in dogs, immediately above the liver.

The spermatic arteries *aa* Fig. 24. arise from the descending trunk of the great artery, and pass thro' a very small perforation * - - - made on purpose in the *Vena cava*, and descend strait to the *Testes*, as in human bodies; and are not contorted, as they are found in most if not all quadrupeds; perhaps this perforation of the *Cava* was not only designed for transmitting the spermatic arteries, but might also frame an *Annulus*, to check the velocity the blood would otherwise have in those arteries, which rapid motion of the blood we find nature studiously avoids in the *Testes* of all animals; for in men we see these spermatic arteries (contrary to all other trunks of arteries) are smaller at their originations from the great artery; and in quadrupeds, excepting in this, the spermatic arteries are contorted before they reach the *Testes*. These spermatic veins, after leaving the *Testes* of this animal, have (like those of human bodies) several divisions and anastomoses, which are all reduced to one trunk on each side, and empty themselves into the *Cava* immediately above the perforation *bb*: Upon dividing the *Tunica vaginales* *RR* Fig. 24, 25, Mr. Cowper found the inclosed testicle and its *Epididymis* lying loose, inasmuch that they parted from each other as expressed *W X Y Z*; and with a pretty large convex-glass he could see the excretory duct *Z* arising from one extremity of the testicle, where the spermatic artery and vein *Y* may be seen; after that duct has gone a little way it is folded up into the *Epididymis* *W W*, and at length it forms the *Vas deferens* *SS*; in men and in most if not all quadrupeds, the *Epididymides* and *Testes* adhere so close to each other, that without some dexterity in dissection, their origin from the *Testes* is not to be discovered: The *Vasa deferentia* *SS* after they leave the *Preparantia* *ab*, as in men and other animals, become somewhat larger, but upon crossing the *Ureters* *ee*, become smaller again at their entrance into the

Ure-

Urethra, immediately below the neck of the bladder; where their orifices could be perceived on each side of a caruncle; nor are there any *Vesiculae seminales* near the *Vasa deferentia* of this animal, as in boars, bulls, horses, &c. which nevertheless cannot be allowed to communicate with each other, as in men; for tho' the *Vasa deferentia* and *Vesiculae seminales* of those last mentioned animals empty themselves into the *Urethra* at the same orifices with the *Vesiculae seminales*, yet their communicant ducts are so very short, that whatever comes by the *Vasa deferentia* will sooner escape into the *Urethra*, than be received by the *Vesiculae*, as in men; the length of the *Urethra* between the bladder and the *Penis* exceeded four inches, of which more than three inches and a half was inclosed with a glandulous body, analogous to the *Prostate* in men and other animals; the orifices of the secretory ducts of this glandulous body are very numerous, and open into the *Urethra* on all sides, as appeared upon opening the *Urethra* and compressing this glandulous body or the *Prostate*, its secreted liquor started out; this part of the *Urethra* I K K L, Fig. 24, 25, thus inclosed with the *Prostate*, being very much contorted or folded in its natural situation between the bladder and the *Penis*, when there is no erection, must necessarily be drawn out, and become strait, when the *Penis* is extruded upon an erection; by which means the glandulous body is necessarily compressed, and the *Succus prostaticus* forced into the *Urethra*; the *Prostate* of divers animals are composed by muscles framed on purpose, that inclose them, as in boars, rams, &c. but in men they are compressed by the *Musculi levatores ani*: At the root of the *Penis* of the *Opussum* we meet with four glandulous *Vesiculae* M M N N; two on each side, which empty themselves into the *Urethra*, and contain a mucous matter, like that Mr. Cowper found in the glands he discovered in this part in men; these *Vesiculae* are not only compressed by the thin broad *Sphincter* muscle above-mentioned, but the bulbs of the cavernous bodies of the *Penis* C C and *Urethra* E E, when distended in the erection of the *Penis*, do also compress these mucous bags; this compression in men is effected by the intumescence of the bulb of the cavernous body of the *Urethra*; in boars, rams, cats, &c. we find nature so solicitous to discharge the contents of the excretory ducts of these glands, that (like the gizzard of birds) each mucous gland is inclosed with a proper muscle to compress it.

The structure of the *Penis* differed in several respects from what Mr. Cowper found, in all the other animals he had dissected;

besides, the forked *Glans* B B Fig. 24, 25, its cavernous bodies D D had no connection with the *Ossa pubis*, nor did the *Musculi erectores* or *directores* C C adhere to any bone, as in men and quadrupeds, but all those parts lay loose under the *Ossa pubis*; the other extremities of the two *Corpora cavernosa* *Penis* are receiv'd into the *Glans*; neither did the *Corpus cavernosum Urethrae*, or its muscles E E adhere to the *Sphincter Ani*, as in most other animals, but the whole body of the *Penis* lay loose between the bones of the *Pubis* and *Rectum*; so that on the intumescence or erection of the *Penis*, it is at liberty to be extruded from its *Præputium*, wherein it is secured from outward injuries, when not erected; to favour this extrusion of the *Penis* in this animal, the *Urethra* I K L is not only very long between it and the bladder O O, but he found it much more contorted or folded into acuter angles, than is expressed in the figures, else the *Penis* could not be extruded, but the bladder O O must follow it; besides, it appears that nature designed this extrusion of the *Penis* in its erection, because we meet with instruments to draw it back again into the *Præputium*; ff G shews a pair of muscles elegantly framed for that purpose on the fore-part of the *Penis*; they arise fleshy from the *Corpora cavernosa* *Penis* D D and becoming tendinous at ff, as they pass thro' two ligaments or pulleys on the *Ossa Pubis*, they are afterwards united into one tendon G, which is inserted at the upper-part, or *Dorsum Penis*; besides, this pair of muscles (which perhaps is peculiar to this animal) he found another pair, that also withdrew the *Penis*, which arise from the *Rectum*, and are inserted into the extremities of the *Corpora cavernosa* *Penis*; in cats, male porpoises, bulls, rams and boars, we meet with two ligaments arising from the *Os sacrum* or *Ilium* on each side, and inserted into the *Corpora cavernosa* *Penis* of those animals, which like these muscles serve to draw in the *Penis* of these animals into the *Præputium*: The *Corpora cavernosa* *Penis* of the *Opossum* differ in their figure from what we find in other animals; their upper parts D D are bulbous and are covered with muscles C C, like the bulb of the cavernous body of the *Urethra* in men; but in other animals those parts of the *Corpora cavernosa* *Penis* are of a conical figure; the muscles of the cavernous bodies of the *Penis* in this animal having no connection with the *Os pubis*, cannot apply the *Dorsum Penis* to the last named bone, and compress the vein of the *Penis*, thereby to retard the reflux blood, and cause an erection as we have observed in other animals, but some large veins of the *Penis* in this place take a different course, and pass thro' the middle

middle parts of the bulb K K C Fig. 26. and are only liable to the compression made by the intumescence of these muscles C C, that inclose them; but the chief agent in continuing the erection of the *Penis* in this animal, is the *Sphincter* muscle of its *Anus* or rather *Cloaca*, to which the broad *Sphincter* muscle above-mentioned is continued, and does somewhat contribute; when the *Penis* is extruded from the *Cloaca* (which must happen when it is erected) the *Sphincter* of that part necessarily embraces it, and the like must be done by the *Sphincter* muscle of the *Cloaca* of the female in *Coitu*; and upon these accounts Mr. Cowper is apt to think, these animals are not very quick in that act; besides, the shape of the *Penis* shews an unsuitness for its retraction, 'till there is a detumescence of its *Glans* A B Fig. 26; which perhaps does not happen in these animals 'till both male and female are satiated, as in dogs and other animals that have bones in their *Penis*, and have a bulbous intumescence of the *Glans* in *Coitu*, and no *Vesiculæ seminales* as in this animal, and do also impregnate the female with more than two or three at a time, as the *Opossum* does: As the bulb of the cavernous body of the *Urethra* in man, is framed for the use of the *Glans*, to keep it sufficiently distended when required; so it seems, that it is necessary to have two of those bulbs inclosed with their particular muscles E E Fig. 24. in this animal, to maintain the turgescence of its doubled or forked *Glans* A B Fig. 26. when the *Penis* is erected; in this distension of the *Glans Penis*, the middle part of the orifice of the *Urethra* (where you see the probe passing out of Fig. 25.) is necessarily compressed, as represented by D Fig. 26. and two distinct apertures C C are left open, as appears by A B on each side its forked *Glans*.

Such as suppose that an *Aura seminalis* of the male, passes by the way of the blood of the female, to her *Ovaria*, to fecundate the *Ova*, will here find an instance, which Mr. Cowper must leave them to solve; for to what end has nature contrived a double *Glans*, and two distinct apertures therein (when its *Penis* is erected) for the *Semen* of the male *Opossum*, supposing she has designed the impregnation of a double *Uterus* of the female? Certainly one passage in the *Glans Penis* would have been sufficient to convey the *Semen masculinum* to the mass of blood of the female, in the manner they suppose, had not the propagation of the species depended thereon; and doubtless, it was for that end chiefly, that the *Penis* of this animal differs so much from what we meet with in others; nor could its *Penis* in these circumstances be exposed in a *Preputium*, as in other quadrupeds,

peda, by reason of the numerous accidents that would certainly attend in this animal's way of living; nor could its *Penis* be thus retracted, when not erected, and sufficiently extruded, when it is, if (as in other animals that are also retromingent) the *Penis* of the *Opossum* had been fastened to the *Ossa pubis*.

Thus we see, that nature in these instances, accomplishes the same ends by different methods; tho' there are no *Vesiculae seminales* in this animal, as there are in dogs, weasels, &c. yet we find its *Penis* without a bone, as in those animals; but then we meet here with additional contrivances to maintain its erection; and not only the *Sphincter* muscle Fig. 25. of the *Cloaca* of the male *Opossum*, but that of the female does also closely embrace its *Penis* in *Coitu*, and effectually retard the reflux blood from its *Corpora cavernosa*, by compressing the veins of the *Penis* E. Fig. 26; nor could the *Penis* of this animal be formed like that in boars, rams, bulls, &c. in whom the *Corpora cavernosa* are too large, when not erected, to be secured within the *Cloaca* of this animal.

Fig. 23. Shews the external appearance of the genitals of the male *Opossum*, somewhat less than the life; A B c c the *Anus* or *Cloaca*; A its lower part which leads to the *Rectum*; B its upper part of the orifice of the *Præputium*, whence the urine and the *Penis* are extruded; c c two small apertures, whence the yellowish liquor that had the peculiar *Favor* of the animal, had its exit; D the *Scrotum* just large enough to contain the *Testes*; E that part of the *Abdomen* where the *Marsupium* is seen in the female, which here appears a little more depressed than in other animals: but cannot contain the young ones, as the pouch of the female does; E E the two thumbs of the hinder feet or hands.

Fig. 24. Represents the fore-parts of the organs of generation, done as large as the life; AA the body of the *Penis*; A B the forked *Glans*; C C the muscles analogous to the *Directores Penis* in men and other animals, which here inclose the *Bulbi* of the cavernous bodies of the *Penis*; D D the two *Corpora cavernosa* *Penis* before they join, and form the body of the *Penis*; E E parts of the two bulbs of the cavernous body of the *Urethra*; G ff a pair of muscles, whose two tendons ff pass thro' two ligaments or pulleys on the *Ossa pubis*, and are afterwards united into one tendon G, inserted into the *Dorsum Penis*, and serve to draw the *Penis* within the *Cloaca* after an erection; H H two other muscles which serve for the same use, and arise from the *Rectum*, but they are fastened to the opposite part of the *Corpora cavernosa*.

cavernosa Penis; I the *Urethra*, where it has no glandulous body inclosing it; K K the *Prostate* or *Corpus glandulosum*, inclosing the *Urethra*, which lies contorted between the *Penis* and bladder of urine in the *Pelvis* of the *Abdomen* of this animal; M N two mucous bags on each side, at the root of the *Penis*, which empty themselves into the *Urethra*; O O the bladder; P P the *Musculi cremasteres*; Q Q the left cremaster inclosing the *Tunica vaginalis*; R R the *Tunica vaginalis* of the right side, laid open to shew the inclosed *Vasa preparantia* & *Vas deferens*; S S the *Vas deferens*; T V the *Tunica vaginalis* inclosing the left testicle, with its *Epididymis* V; W X Y Z the right testicle as it appeared upon opening the *Tunica vaginalis*; W its *Epididymis*; X the body of the testicle; Y the spermatic vein and artery as they pass to and from the testicle; Z the excretory duct of the testicle which could be distinctly seen arising from the *Testes* and marching to the *Epididymis* W, where it is folded up and constitutes that body, from whence it is continued to the bladder, and called the *Vas deferens*, S S; a a the spermatic arteries arising from the fore-part of the descending trunk of the *Arteria magna*, where they have a common duct, which is divided as it passes thro' an aperture * - - - formed on purpose in the trunk of the *Vena cava*; b b the spermatic veins at their entrance into the *Cava*; d d the kidneys; e e the ureters; g g the emulgent veins; ♀ part of the left emulgent artery; h the *Vena cava* below the liver; i i the descending trunk of the great artery; k k the mesenteric arteries; l the lower mesenteric artery, which in this animal does not arise from the great trunk; m the left *Glandula renalis*, that on the right-side being placed behind the trunk of the *Vena cava* n; o a common trunk of an artery, from whence arises the gastric, the superior and inferior mesenteric, and the emulgent arteries: The design of nature in confining all those arteries to one trunk in this animal, might be, perhaps, in favour of its usual posture, in hanging by its tail with its head downwards; this trunk of the arteries of the *Viscera* of the lower belly having so many united forces, is the less liable to any compression that might be made by its contained parts in that posture.

Fig. 25. Represents the back part of the genitals; A the body of the *Penis*; B its *Glans*; C C the *bulbi* of the *Corpora cavernosa Penis* covered with their muscles; D D the *Corpora cavernosa Penis*; E E - - - the two distinct bulbs of the cavernous body of the *Urethra*, inclosed with their particular muscles; F F G parts of the muscles expressed on the fore-part of

of the *Penis* in the preceeding figure; H H the other pair of muscles arising from the *Rectum*, and inserted into the sides of the *Corpora cavernosa Penis*; I K L the *Urethra* covered with the *Prostate* K L K; M N the two mucous bags on each side; O the bladder; P the *Musculus cremaster*; Q the *Tunica vaginalis* laid open; R the *Vasa preparantia* cut from the great trunks; S S the *Vas deferens* on each side; W X Y Z; the left testicle, as in the preceeding figure, only, that the opposite side is here towards you; ee parts of the *Ureters*; ** a probe inserted into a part of the *Urethra*.

Fig. 26. The fore-part of the *Penis*, as it appears when its *Corpora cavernosa* are filled with mercury and dried, represented as large as the life; A B its forked *Glans*; C C - - - the two distinct apertures that appear in this distension or erection of its *Corpora cavernosa*; D - - - the middle part of the orifice of the *Urethra*, which is shut up upon the intumescence or erection of the *Penis*; E - - - the two veins of the *Glans*, which are compressed by the two *Sphincter* muscles of the male and female in *Coitu*; F the bulbs of one of the cavernous bodies of the *Penis* distended; G one of the bulbs of the cavernous body of the *Urethra* also distended; these bulbs were opened on the other side Ψ to inject the cavernous bodies with mercury, which are all expressed as they ought to appear on both sides in the following figure; H the *Urethra*; I the muscles dried, expressed in Fig. 24, 25, by F F, ff G; K k the veins tied up as they pass the muscles of the *Bulbi*, to retain the mercury.

Fig. 27. Represents the back part of the *Penis* expressed in the preceeding figure; A B its forked *Glans*; E E parts of the veins arising from the *Glans*; F F the bulbs of the cavernous bodies of the *Penis*; G G the two bulbs of the cavernous body of the *Urethra*; H the *Urethra*; K K k k the veins tied up as they pass out of the *Bulbi*, to retain the mercury.

The Jesuits Bark; by Dr. William Oliver. Phil. Transf.
N^o 290. p. 1596.

THE *Peruvian* bark comes from a tree about the bigness of a plumb-tree, with leaves like ivy, but a little smaller, which are always green; the *Indians* call it *Querang*; it is gather'd in autumn, at which time, the rind is stripp'd off all round, as well from the trunk as from the boughs, which grows again in four months, as cork does; the trunk is about the bigness of a man's thigh; it bears a fruit not unlike a chesnut (excepting its outer rind or shell) which is properly call'd *China China*, and is esteem'd



esteem'd by the natives beyond the bark taken from the trunk or boughs; this account the Dr. had from an apothecary in *Cadiz* in *Spain*, who had liv'd in *Peru*, and had seen it growing, and gather'd it several times; from which account the Dr. made this observation, that probably *China-China*, or the rind of the fruit, was first only in use, and the more powerful medicine, taken in smaller quantities; and that the bark of the tree came not into use till some time after, when the virtues of it being known in *Europe*, occasion'd a greater demand for it.

A new Baroscope, and Observations made therewith; by Mr. Caswell. Phil. Trans. N° 290. 1597.

SUPPOSE ABCD Pl. X. Fi. 1. to be a bucket of water, in which is the baroscope *xrezyosm*, consisting of a body *xrsm* and a tube *ezyo*, both which are concave cylinders communicating with each other, and made of tin, for want of glass; the bottom of the tube *zy* has a lead weight to sink it, so that the top of the body may just swim level with the surface of the water, by the addition of some grain-weights on the top; the water, when the instrument is forced with its mouth downwards, gets up into the tube to the height *yu*; on the top there is added a small concave cylinder, which he calls the pipe, to distinguish it from the small bottom cylinder, which he calls the tube; this pipe is to sustain the instrument that it may not sink to the bottom; *md* is a wire; *ms*, *de* are two threads, lying oblique to the surface of the water, which threads perform the office of diagonals; for while the instrument sinks more or less by the alteration of the gravity of the air, there, where the surface of the water cuts the thread, is form'd a small bubble, which ascends up the thread, whilst the mercury of the common baroscope ascends; the circumference of the body is 21 inches, therefore its area is ≈ 35 ; the altitude $ms = 4$; therefore the solidity of the body is ≈ 140 ; each base *xm*, *rs* has a convexity, whose altitude is ≈ 6 ; therefore, the conoid on each base is nearly $\approx 11 \frac{1}{2}$, therefore the whole body is $\approx 140 + 11 \frac{1}{2} + 11 \frac{1}{2} = 163$, and the entire altitude of the body $\approx 4 + .65 + .65 = 5.3$; the inner circumference of the tube is 5.014, therefore its area $n \approx 2$; the length of the tube ≈ 4.5 ; therefore the tubes capacity is ≈ 9 ; therefore C the contents of the body and tube $\approx 163 + 9 = 172$ cubic inches, which is almost two quarts and a half; suppose the greatest pressure of the air to be ≈ 30.5 inches of mercury $\approx 30.5 \times 14 = 427$ of water, and $f = 427$; therefore $fc = 73444$; put *a* for the depth *ou* of the air in the tube,

when the body is all immers'd, the air in the instrument, on immersion, contracts somewhat by the cold of the water; this contraction Mr. *Caswell* finds to be nearly as much as would be produced by an addition of one inch to 427, the altitude of the atmosphere in cold weather, but in warm weather it is probably twice as much; but we will now suppose it $= 1$; therefore the depth of the surface of the water in the tube below the surface of the outer water is $= b + a$; therefore, the pressure on that inner surface is as the altitude of the atmosphere above it $= f + b + 1 + a = F + a$, putting $F = f + b + 1$; then seeing that the spaces, into which the air is contracted, are reciprocal to their respective pressures, and that whilst the instrument is out of the water, the pressure f answers to the space C ; therefore $F + a : f :: C : \frac{fC}{F + a}$ = the space which the air takes up

in the instrument under water; therefore $\frac{fC}{F + a} = d$ = that part of the tube which is possess'd by the air $= an$ (supposing the tube's area $= n$) therefore $fC = Fd - ad = Fan + aan$, therefore $aa + F + \frac{d}{n} \times a = \frac{fC - Fd}{n}$; put $F + \frac{d}{n} = 2g$; therefore $aa + 2ga = \frac{fC - Fd}{n}$; therefore $a = \sqrt{\frac{fC - Fd}{n} + gg - g}$; then suppose the gravity of the atmosphere less, so much as to sink the mercury $\frac{1}{10}$ of an inch $= 1.4$ of water; and therefore, putting $\phi = F - 1.4$, and in the last equation a instead of a , and γ instead of g , you have $a = \sqrt{\frac{fC - \phi d}{n} + \gamma\gamma - \gamma}$; thus Mr. *Caswell* finds

$a = 2.723$ and therefore $a - a = .22$; which $.22 \times n$ gives $.44$ cubic inches (and supposing a cubic inch $= 253$ grains) $.44 \times 253 = 111$ grains weight of water, that was got up into the tube in the first case more than in the second; and therefore, the baroscope requires an addition of 111 grains on its top to sink it to the level of the water in the second case, more than in the first, and this upon the sinking of the mercury in the common baroscope only $\frac{1}{10}$ of an inch; now one grain in this new baroscope is nearly as discernible as $\frac{1}{10}$ of an inch in the common one; so that this new baroscope is 111 times more exact than the common one.

Put $f = 247$; $c = 172$; $d = 163$; $n = 2$ as above, only change F , putting it 437.3; that is, suppose the body sunk in water four inches lower; in this case $a = 208$; therefore $a - a = .64$, which multiplied into $\phi n = 1.28$ cubic inches, which $\times 253$ gives 324 grains; and the body's top xm being sunk four inches under water the body becomes so much the heavier, than whilst xm was at the surface of the water; therefore this 1.28 divided by the aforesaid depth 4, gives .32 the area of the top-pipe, such as would balance or buoy up the body at any depth; strictly speaking, the pipe should be gradually bigger upwards in order to sustain the instrument at any depth, but as to outward appearance it is cylindrical, and its circumference = 3.005; but as to that, the least alteration of the air would make xm the top of the body in that case pass thro' the 4 inches (which 4 inches he supposes for all the variety of depth the instrument has room given it on the bucket to ascend or descend) therefore, the pipe is made a small matter bigger; viz. its circumference is 3.14, whereby the pipe, according as the body sinks more, gives more resistance to the descending body; the pipe's area is .3643, therefore the capacity of the pipe in 4 inches altitude is = 1.457; but in order to give no resistance, its capacity as aforesaid should be 1.28, therefore this 1.28 taken from 1.457 there remains .177 the actual resistance in 4 four inches depth; viz. $.177 \times 253 = 44$ grains: But this resistance will not be the same in all weathers; in order therefore to calculate what it will be, when the mercury of the common baroscope is very low; for instance, but 28 inches high = 392 of water; f must be supposed = 392; therefore, $F = f + b + 1 = 398.3$; and the rest as before; viz. $d = 163$; $fc = 67424$; $Fd = 649229$; thence by the aforesaid equation $\frac{a}{a} = \frac{2.59}{2.84}$ therefore, $a - a = .25$, which $\times n$ gives 50. cubic inches, which $\times 253 = 126$ grains; so that this baroscope, when the mercury is lowest, is 126 times more exact than the common one, supposing the body immers'd anew when the mercury is so low; next, whilst the mercury is so very low, suppose the top of the body depress'd 4 inches under water; therefore, $\phi = F + 4 = 402.3$; the rest as before; viz. $fc = 67424$; then, a will be 1.9; but before, whilst the top of the body was at the surface, a was 2.59; therefore the difference .69 $\times 2$ the area of the tube, gives 1.38 cubic inches, which $\times 253$ gives 349 grains; and so much heavier is the baroscope, when the top xm is 4 inches under water; or which comes to the same, supposing that mercury at 28, and xm at the surface, this

baroscope by the mercury ascending $\frac{1}{2}$ of an Inch will become 349 grains heavier; the pipe's capacity in 4 inches altitude was 1.457, from which subtracting the abovesaid 1.38, the residue is $\approx .077$, which $\times 253$ gives 19 grains in 4 inches; so that the pipe will sustain the baroscope, and also 44, when the mercury is 30 and $\frac{1}{2}$ high, and but 19 grains, when the mercury is 28 high; the fewer grains difference there are in its sinking, thro' 4 inches, the more nice the baroscope will be: Where the thread cuts the surface of the water, there is form'd a bubble; therefore, whilst the instrument sinks 4 inches in water (which is all the room Mr. *Caswell* gives it) the bubble moves 20 inches on the diagonal threads; therefore it follows, that 120 grains difference would make the bubble go over the space of 120 inches, were the threads so long; but as it has been calculated above, about 120 grains difference of weight in the instrument is produced by so much of the alteration of the air, as would make the mercury of the common baroscope $\frac{1}{2}$ of an inch; therefore when the mercury ascends $\frac{1}{2}$ of an inch, the bubble of this new baroscope ascends 120 inches; therefore this new baroscope is about 1200 times more exact than the common one. Mr. *Caswell* made the following observations with this new baroscope,

1. Whilst the mercury of the common baroscope is often known to be stationary 24 hours together, the bubble of the new baroscope is rarely found to stand still one minute.
2. Suppose the gravity of the air increasing, and accordingly the bubble ascending; during the time that it ascends 20 inches, it will have several short descents, of the quantity of $\frac{1}{2}$, 1, 2, 3, or more inches, each of which being over it will ascend again; these retrocessions are frequent, and of all varieties both in quantity and duration; so that there is no judging of the general course of the bubble by bare inspection, tho' you see it moving, but by waiting a little time.
3. A small blast of wind will make the bubble descend; a blast that cannot be heard in a chamber, will sensibly force the bubble downwards; the blasts of wind sensible abroad cause several of the above-said retrocessions, or accelerations in the general course; as Mr. *Caswell* found by carrying his baroscope to a place, where the wind was perceptible.
4. Clouds make the bubble descend; a small cloud approaching to the *Zenith* has more effect than a large cloud near the *Horizon*; the bubble descending in cloudy weather, a break of the cloud, or clear place approaching to the *Zenith* has made the bubble ascend; and after that break had pass'd a considerable way beyond the *Zenith*, the bubble descended again.
5. All clouds excepting one, hi-

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thence observ'd by Mr. Caswell, made the bubble descend; but at one time the wind being north, and the course of the bubble descending, he saw to the windward a large thick cloud near the *Horizon*, and the bubble still descended; but as this cloud approach'd to the *Zenith* it made the bubble ascend, and it continu'd ascending, till the cloud was pass'd, after which it resum'd its former descent; it was a cloud that yielded a cold shower of small hail.

Concerning Fossils; by Mr. Edward Lhwyd. Phil. Trans. N^o 291. p. 1566.

THE state of fossils is quite different in *Essex*, from what it is in *Wales* and *Ireland*; in these latter countries the shells are generally crystalline; but in *Essex*, and sometimes about *Oxford*, they are testaceous; which difference is, doubtless, to be attributed to the soil, and particularly, to the chalk and flint of *Essex*, which all those countries want, excepting a small part got in the north of *Ireland*; but there it is remarkable, that their chalk is absolutely petrified; he means, that whereas the flints are in *England* imbedded in chalk, they are there in a chalk-white lime-stone; and as chalky countries alone afford those *Echinite* Mr. Lhwyd styles *pileatus*, *galeatus* & *cordatus*; so he could never find them in all his travels, but at that place, from whence the *Druids* did in time of *Paganism*, procure them, and sold them amongst our northern *Britons* for stones of miraculous efficacy against perils by fire and water; persuading the vulgar that they were generated in cocks knees, as thousands in the *Highlands* foolishly believe at this day. Mr. Lhwyd was surpris'd that so many fossils found in *Essex*, were scarce distinguishable from sea-shells, for the case is otherwise in those places he search'd; about *Oxford* they have, indeed, one or two fossil shells of a testaceous substance, but in colour they differ farther from those of the sea, than the *Essex* fossils do, where they are sometimes found imbedded in solid stone, which takes off any objection some might offer, of their being scatter'd accidentally by gulls, crows, &c. on the *Harwich Cliffs*.

Harwich Cliffs and Fossil-shells found there; by Mr. Samuel Dale. Phil. Trans. N^o 291. p. 1568.

Harwich Cliff is a sort of promontory, which divides *Orwell Haven* from the *Æstuarium* contain'd between that and *Walton-ness*; it is situated on the southern part of the town, about a quarter of a mile distant therefrom, and it contains several

veral acres of land; its height from the strand or beach to the top, is 40 or 50 foot, where it is highest; at the bottom of this cliff there is a *Stratum* of clay about a foot thick, over which there is another of stone for a foot more, in which are embodied divers shells (tho' but thinly) as well of the turbinate as bivalve kind, and also pieces of wood and sticks; over this are divers *Serata* of a blueish clay, about 10 foot high or more; this clay hath *Pyrites* or copperas stones sticking therein, but no shells that Mr. Dale could observe; above this are likewise divers *Serata*, reaching within two foot of the surface; some of which are only of fine sand, having other small stones and gravel mix'd with fragments of shells, and in others were small pebbles; and it is in some of these last mention'd *Serata*, that the bivalve and turbinate fossils are embodied, which lie promiscuously together; the *Serata* with the shells observe no order in lying, being sometimes higher and sometimes lower in the cliff; and sometimes two or three one above another, with other intermediate *Serata* of sand, fragments and gravel; over all these, there is a covering of common sandy earth, which is about two foot thick; in some places of which there are veins of a species of *Osteocolla*, tho' more tender than the *Osteocolla Officinarum*, which is brought from Germany; this Mr. Dale calls *Osteocolla Anglicana*, which incrustates round small strings like the fibres of the roots of trees; it is of various sizes, and emits branches here and there; but it is so tender, as not to be got out of the earth in any large pieces; whether it appears above the earth, like the German sort, Mr. Dale could never discover; the shore before this cliff, as far as the ebbing of the sea would permit his observation, was rudely pav'd with stones, divers of which are vein'd with that sort of substance, which by *Helmont* and other naturalists, is call'd *Ludus Paracelsi*; the inhabitants have a tradition, that these stones are form'd by the clay, which tumbling down from the cliff, and being wash'd by the flowing of the sea, are in a short time converted into stone; and Mr. Silas Tayler in his manuscript collections of *Harwich* and *Dover-cours* writes thus concerning it; *The washing of these cliffs discovers a blueish clay, which tumbling down upon the shore, tho' wash'd by the sea at high water, within a short time turns into stone; there may be seen some that are newly fallen, as soft as the clay in the cliff, and others that have lain longer there, crusted over and hard, but if open'd or broke, the clay is still soft in the middle; others, that have lain longest are petrified to the very middle, and with these the walls of the town are built for the most part, and the streets* gene-

generally pitch'd: How far this is matter of fact Mr. Dale will not determine; and tho' he must at the same time own that several of the stones are wash'd from the *Stratum* at the bottom of the cliff, yet he was sometimes inclin'd to Mr. Tayler's opinion, because he liv'd a great while upon the spot, and by his collections seems to be a person of probity and learning; and likewise, because, several of the said stones have cracks or chops in them, as clay and earth commonly have by being expos'd to the sun, and there is still lying upon that shore a stone, in which a large pile (probably of oak, such as was formerly made use of there to preserve the cliff from the injuries of the sea) plainly appears to have been imbedded, which can owe its situation to no other cause, than by being press'd into the superficies of the clay while soft, and petrifying with it; which being square, takes off an objection some might make, had it been round, of its being lodged there at the general deluge; Mr. Dale is not insensible that this manner of petrification is not only different from the common methods nature uses in that operation, but also thwarts the opinions of divers learned and ingenious men; and it was strenuously oppos'd by Mr. Morton of Oxendon in Northamptonshire, when he and Mr. Luffkin were with Mr. Dale upon the spot; the substance of his discourse was to the following purpose. *At Harwich, under the cliff upon the sea shore, there is a Stratum of a clayey stone, which is cover'd here and there with ragged stones of a closer texture, which was formerly another entire Stratum, but was thus broken by the tearing of the waves; Mr. Dale and Mr. Luffkin were of opinion that this clayey Stratum had been formerly a softer substance, but was daily petrified by the sea water; when I turn'd to the cliff I found a Stratum there, of the very same sort of clayey stone with that upon the shore; yet the sea water very seldom comes up hither, unless driven by storms and at spring tides; I broke off a little piece, and then you was convinc'd that it was not harden'd or petrified by the sea water, but in its natural state; and I have often met with just such sort of stone in several of our stone-pits here in the inland country; it appears to me, that the water should have rather soften'd than harden'd the stone upon the shore, tho' by washing away the looser clayey matter and other earthy stuff, that is sometimes left upon it at the ebb, it might seem to be a sort of petrification, and occasion this mistake.*

As to petrifications, I have only observ'd these three sorts.
 1. *A stony incrustation upon sticks, and any thing that lies in the*
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the way, in petrifying springs; the soil in those waters is usually intermix'd with particles of stone, that trickle down into it with the water, and are there detain'd; of this first sort, doubtless you have several instances in Essex, and I think there is one at Harwich-cliff; tho' this is not so properly call'd a petrification. 2. The second sort is that which is perform'd by the permeation, or insinuation of the finer sorts of stony particles; as is the case in some of our petrifying waters, particularly, that at Knareborough; the stony particles of the Knareborough-spring are very fine; and several of the fossil shells have undergone the same fate. 3. The third sort, which indeed is a petrification properly so call'd, is often met with on the sides of caves and grotto's, as at Pooley-hole in the Peak; and in the fissures and clefts of mines and quarries; of this kind are the several sorts of fluors, the Lapidés stillatitii, stalagmitæ, &c. that we meet with in the fissures and Hiatus of the earth; these are continually receiving an additional increase of real and solid stone, as is observ'd in several caves in the Peak, &c. this I take to be perform'd in such a manner as the incrustations are; viz. the particles of stone are brought along with the water as their vehicle, and at length are deposited upon the sides of the cave or fissure; but here the particles of stone are exceeding minute and fine, and do thereby naturally concrete and join very close together; whereas, in our incrustations, the particles of stone being grosser, the stone is rough, coarse, and friable; and this I leave to your judgment if it be not a more reasonable Hypothesis than that of Dr. Plot in p. 33. of his history of Oxfordshire, viz. that the very body of the water is turn'd into stone, as it chops down from the rocks: As to that Hypothesis of the transmutation of a Stratum; e. gr. of chalk to clay, of coal to common stone, or the like; I must confess, I never met with any thing in nature, which would countenance it, that is such a transmutation in the bowels of the earth; nor is, there any thing that proves it, that ever I met with in any natural observations.

A late author is of opinion, that this bed of stones was the foundation of the loamy cliff, where the cliff has been wash'd away or cut; and that they are the production of a vitriolick juice in conjunction with the loam; as the common copperas stones are produced by the same juice in gravel; and that the latter were only to be found, where the cliff was gravelly, and not where the loam is; how far these stones are the effect of a vitrioline juice, Mr. Dale will not determine, but this he can affirm,

affirm, that he has by him some of the *Pyrites* or common Copperas stones, which he pick'd out of the clayey *Stratum* of this cliff, in which they may be frequently met with; nor did he observe at any time, that these stones were invested with either *Gypsum* or *Trichitis*, as the same author affirms, but with the aforesaid *Lodus Paracelsi*, and frequently some other sorts of *Lapides Stalagmitæ*.

How these shells or marine bodies came to be deposited here, is a subject which has employ'd the heads and pens of divers learned and ingenious men; of which Mr. Dale would not pretend to say any thing, only make some remarks on the positive assertion of the aforesaid author, concerning the imbedding of these fossil shells in this cliff and the alteration of the channel; viz. that this bed of shells, which covers the cliff, was carried thither, either at the making or clearing of the harbour; for the channel or harbour there is artificial, and of no old date, the current having been formerly on the other side of *Languard Fort*, which then stood in *Essex*; as to the question, how else could the shells lie a-top of this cliff? Mr. Dale would only ask, why the same *Strata* of sand and fragments of shells, with the like fossils imbedded therein, are to be found at *Walton-ness*, on the other side of the *Æstuarium*, which is five or six miles broad from *Harwich*, as also at *Bawdsey-cliff* in *Suffolk*, which is eight or nine miles distant, and in other cliffs on that shore, where Mr. Dale had met with them; a second question may here be ask'd, how it comes to pass that none of those *Buccine heterostrophæ* (whose *exuvie* are in such plenty in all the cliffs hereabouts) are not now to be found in this channel, nor in the adjacent sea? For Mr. Dale cannot think, that the clearing this harbour could have destroy'd all that species of shell-fish, whereof there was then such plenty; and therefore, some other original must be allow'd them, than what this author has assign'd; nor can Mr. Dale allow the harbour here to be artificial; because, so great a work as this is; viz. the making a channel two miles wide, as it is in this place, would not have been done, without some notice taken thereof in history; and besides, the earth, &c. which must have been dug up by such a work, must, consequently, have made a much greater hill, than the cliff ever was; and another doubt will arise from hence, why the workmen should bring all the earth, &c. to this side of the channel, and not lay some of it on the other, as it is plain they did not; the ground on which *Languard-Fort* stands, as far as *Walton Cole-ness*, which is about three miles, is only a sandy level or beach,

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 which Mr. Dale supposes might in time have subsided there, as may be observ'd at the mouths of other large rivers; and as to the argument our author alledges of *Languard Port* being accounted to stand in *Essex*, to confirm his Hypothesis of the change of this channel; it will be of no force with any one, who does but observe, that not only parts of parishes, but likewise counties, are often divided from those parishes, and counties to which they formerly belong'd, and included in others, of which there could many instances be given; e. g. a part of *Ken* is on the *Essex* side of the *Thames*; and in *Oxfordshire*, the parishes of *Shilton* belong to *Berkshire*, *Daylesford* to *Warwickshire*, *Campton* to *Gloucestershire*, and *Sratton Audley* to *Buckinghamshire*, tho' all are included in the other; and there is a farm belonging to the parish of *Braine-tree*, that is separated from it at least two miles; and to Mr. Dale a probable reason of this fort being reckon'd in that county, is the lands subsiding here, made at first an island, which lying nearest to *Essex* was accounted of that county; or secondly, the island so form'd, belonging to none but the crown, it was at the pleasure of the King's officers to call it of which county they had a mind; nor was it Mr. *Taylor*'s ignorance (as this author says) that made him mention these stones as petrifications made by the sea; for in his aforesaid *Collections*, he did not omit the tradition the inhabitants of this town had, about the alteration of the mouth of this haven, as appears from his own words; it is generally believ'd, says he, that *Stour* did formerly discharge itself in a straighter current than it does now, into the sea about *Hoasley Bay*, under the high-land of *Walton-Colene* and *Felix-Stow* in the county of *Suffolk*, between which and *Languard-Port* are (as they are reputed) certain remains of the old channel, which the neighbouring inhabitants still call *Fleets*, retaining at this day the tradition of the course of the water, and the entrance into this haven to have been heretofore by and through them; and Mr. Dale is of opinion, that this tradition is matter of fact, from what he has before hinted concerning the mutations the mouths of large rivers daily undergo, by the lodgment of sand; for which may be assign'd as a better reason for this alteration, than that of our author, i. e. that it was artificial; and the yearly washing of the cliff on the *Harwich* side does likewise add to its probability; it being a constant observation, that where the sea gains on one side, it loses on the other; and that this level was so form'd, he is confirm'd by the modern removal of the fort more towards the point, and that more sand was added after the

the old fort was built; this alteration is taken notice of by the aforesaid Mr. Taylor in these words; *And tho' several now living pretend to remember the building of Languard-Fort, yet we find that there was an older fort thereabouts, A. D. 1553, and call'd by the same name, which was not far off from this modern one, a little north of it, where are still to be seen two faces and flanks of a Bastion, the rest of it being wore away by the sea, but in its stead it has left upon the shore a long row of sand banks.*

The spring mention'd by Mr. Edmund Gibson in his English edition of *Camden*, from the aforesaid manuscript of Mr. Taylor, is a very small inconsiderable thing; nor could Mr. Dale observe, that it petrified or incrustated either pieces of wood or sticks; but he had a piece by him, which he broke off from a large pile upon that shore, which was petrified as far as it was driven into the earth, and the sea water came; and he suppos'd that there still remain some others of the same.

Mr. Dale has already observ'd, that the fossil shells are imbedded in a loose *Stratum* of sand, gravel, &c; which may serve to demonstrate, that their *Matrix* is not a clay-bed upon the top of the cliff; as also, that they could not be scatter'd there by crows, gulls, or other sea-fowl, as well; as that some of them are likewise bedded in stone at the bottom of the cliff, yet it is only where the earth has been broken by digging of ditches, &c.

Mr. Dale found the following fossils at this cliff. 1. *Buccinum fossile heterostrophum rostratum, Levem maximum Listeri referens.* 2. *Buccinum fossile rostratum maximum Listeri referens.* 3. *Buccinum fossile minus ventricosum mucrone obtuso.* 4. *Buccinum fossile tenue minus ponderosum, striatum & undatum.* 5. *Buccinum fossile tenue confragosum.* 6. *Buccinum fossile striis prominulis marginalibus insignitum.* 7. *Buccino-turben fossile reticulatum minus.* 8. *Buccino-turben fossile sulcatum.* 9. *Buccino-turben fossile rostratum.* 10. *Buccino-turben maximum rostratum fossile spiris intris striis elatis insignitis.* 11. *Cochlea fossilis maxima umbilicata quinque spirarum.* 12. *Cochlea fossilis umbilicata mucrone obtuso.* 13. *Nerita parva fossilis.* 14. *Turbo fossilis spiris duabus striis eminentibus insignitis.* 15. *Pecten minor fossilis unica aurica.* 16. *Auricularia maxima.* 17. *Pectunculus fossilis fere circinatus striis tenuibus valvis per ginglymon connexis.* 18. *Pectunculus fossilis crassus rostro acuto striis majoribus.* 19. *Pectunculus fossilis fasciis transversis undantibus notatis.* 20. *Pectunculus vulgaris fossilis.* 21. *Pectunculus fossilis striis majoribus & elatioribus.* 22. *Pectunculus*

unculus maximus fossilis Listerianum maximum referens.
 23. *Pectinoulites maximus striis latis.* 24. *Concha parva fos-*
silis fasciis transversis insignis. 25. *Concha longa fossilis fas-*
ciata. 26. *Conchites levis maxima.* 27. *Conchites parva fas-*
ciata. 28. *Trigonella minor sive vulgarior Anglica Lirboph.*
Britan. 816.

An Instrument for seeing the Sun, Moon, or Stars pass the
Meridian of any place; by Mr. William Derham, Phil.
Trans. N° 291. P. 1578.

AMONGST all the methods contriv'd for finding the me-
 ridian of any place, the most commodious Mr. Derham
 could ever meet with, or think of for common use, is an instru-
 ment of Sir Christopher Wren's, or two of Mr. Gray's, or one
 publish'd in the appendix to the *artificial Clock-maker*: Sir
 Christopher Wren's contrivance is thus; erect a sight at one ex-
 tremity of a ruler, to see the pole-star, &c. thro'; at the other
 extremity set up two circles of small wire, the one within the
 other; let the diameter of the innermost be equal to the double
 tangent of the distance of the pole-star from the Pole; the dis-
 tance of the sight being radius; let the diameter of the outermost
 circle be equal to the double tangent of the distance of the next
 star to the pole-star, from the Pole; having thus prepar'd your
 instrument, if you look thro' the sight, and bring the two cir-
 cles to the two stars, whose distances from the Pole they repre-
 sent; a line passing thro' a sight and center of the circles is the
 elevation of the Pole; and two plumb-lines hang up, one over
 the sight, the other over the center of the two circles, will lie
 exactly in the meridian of the place.

Mr. Derham's instrument is made thus of wood, or rather
 iron or brass, to endure the weather, without swelling or contract-
 ing: viz. prepare a small flat iron-bar, as CC in Plate X. Fig. 2.
 at each extremity of which rivet on two upright sights, to turn
 stiffly at the joints II; let one of the sights *cd* have a perfora-
 tion large enough to see the pole-star thro', the other sight *ab*,
 a very small perforation to see the sun thro'; just behind the
 joints fix two upright arms CD and CD, but so to bend off, as
 to be out of the way of the sights, when you look thro' them;
 these arms should be long enough for the plumb-lines to reach
 the pole-star on one side, and the sun at his greatest altitude on
 the other, when you look thro' either of the sights; therefore, the
 plumb-lines are tangents to their opposite sights, and their lengths
 may be found by a table of natural tangents, making the distance
 of

of the two sights radius; thus in the latitude of London, if the instrument be two foot from sight to sight, the southern plumb-line should be near four foot, and the northern one about two foot ten inches; on the tops of these two arms place two small cross pieces DE and DE, to turn with a joint at D, which cross pieces are to hold the plumb-lines EF and EF, and to turn off and on, so as to bring the plumb-lines exactly to the sights; place this instrument on a pedestal H to turn round on it stily at the pin G; the way to set and use it is thus; plant it in a convenient place, where the pole-star may be seen by night, and the sun by day; whenever that star is on the meridian, is the time to set this instrument; viz. look at the pole-star thro' the sight with the larger hole *cd*, and turn the whole instrument about, till you see the opposite plumb-line exactly to intersect the pole-star; or when you have brought the plumb-line near the star, you may the more easily bring it to intersect the same, by moving the sight *cd* backwards or forwards at the joint I, instead of moving the whole instrument; and that you may the more easily see the pole-star thro' the sight, let the plumb-line be a very fine cat-gut string or horse hair, &c. and if it be white, or of some such light colour, it will be the better seen, with the help of a candle shining thereon in the night, which is necessary; the sight *cd* and the opposite plumb-line being thus set in a direct line with the pole-star on the meridian, it is manifest, that the instrument lies exactly in the meridian, so as to see any star on the meridian to the north; and that you may see the same to the south, next day, or when you please, you may hang up the plumb-line EF upon the southern arm CD, so as that the plumb-line may exactly intersect the perforation *cd*; this may easily be done by moving the top joint with the plumb-line on its cross-piece backwards and forwards, till it hangs to your mind; if the sight with the lesser hole *ab* be not exactly under the northern plumb-line, it must be brought to that position, by turning the sight, by help of its joint at I; and then the whole instrument is adjusted, so as to see the sun, moon, or stars come upon the meridian towards the south; but to see the sun transit the meridian, it is necessary to guard the eye with a colour'd glass, or a glass darken'd with the smoke of a lamp or candle; which may be done in the following manner; chuse two pieces of glass cut into the same size and figure, taking care that they do not refract, which may be known by moving the glass before the eye; if the objects you look on, seem to dance about, the glasses refract; but if every thing seems steady, they are true; smooke one of these glasses.

glasses over the flame of a lamp or candle, till it be sufficiently obscured to take off the rays of the sun, but not so as to darken it too much, which may be seen by looking upon the sun or candle with it; one of the glasses being thus darkened, lodge them both together, and fasten them in a little case fit for the purpose, with the smok'd side innermost, and an edging of card between the glasses to keep them asunder, so as that the foot may not be rubb'd off or disordered; it is proper to have two glasses thus prepared, one for a strong sun, and the other less obscured, for the sun behind a thin cloud, mist, &c. with one of these glasses held behind, or before the sight *a b*, you may plainly see the sun pass.

To imitate the aforesaid Instrument on a Journey or wherever you come.

- Instead of an intire instrument, only prepare two sights, as in Fig. 3. with holes as before; let these sights be nail'd or screw'd down upon the tops of two stakes at *II*, so as to turn stiffly thereon; the plumb-lines, at least one of them, may be hung up at the end of a house, as at *K*, or on the bough of a tree, or wherever you think fit, so as that the wind may not shake it, and the sights must be stuck up so as to bring the pole-star to intersect, and all be performed as has been above directed; this, tho' in a manner the same with the instrument above described, yet is in some respects more convenient; chiefly, because the plumb-lines may be made longer, and the sights set farther asunder than can conveniently be done in the instrument; which, is some little advantage for seeing the transits; these sights may also be made so light, as to be easily portable; or they may be readily made or imitated in any place wherever you come.

To know when the Pole-star comes on the Meridian.

The way is thus; subtract the *Right Ascension* of the sun from the *Right Ascension* of the pole-star, the remainder gives the degrees, minutes and seconds, when the pole-star transits the meridian above the pole; divide these degrees by 15, it gives the hours; and every degree under 15, multiplied by 4 gives the minutes, and every minute multiplied by 4, gives the seconds of the apparent time of the pole-star's southing; it comes under the pole at 12 hours distance, only observing to make some small allowance for the alteration of the sun's *Right Ascension* in that 12 hours time; but to shorten the labour, use tables of the sun's *Right Ascension* in time, instead of degrees, &c. if the sun's *Right Ascension* exceeds that of the pole-star, add 360 degrees, or 24 hours, and then subtract: The *Right Ascension* of the pole-star is determined by Mr. Flamsteed, to be $0^{\circ} 33' 4''$ of

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time *Anno* 1690; and the increase of its *Right Ascension* in 10 years is $1^{\circ} 16'$ of time; or you may see when the pole-star comes to the meridian, by hanging up a plumb-line, and observing when the *Thill-horse* in *Charles's Wain*, called *Alcor*, comes near the line, together with the pole-star on one side of the pole; or the bright star of the third magnitude in *Cassiopea's Thigh* on the other side, as is represented in *Fig. 4*: The foregoing instruments may be set by any other star as well as the pole-star; but the pole-star in our northern hemisphere is most convenient, because it makes but a small circle round the pole, and therefore moves slower and consequently is longer in transiting the meridian; and therefore, a small error in calculation, or a little expense of time, in setting the instrument, may be but little regarded.

The Uses of these Meridian Instruments.

1. You may see with all imaginable exactness, when it is noon, even to 1, 2, or at most 3 seconds of time, for you may see, when the very limb of the sun touches the meridian, and whilst all his disk is passing it; so that it exceeds by much any sun-dial; but besides this, another vast convenience is, that it will fit most latitudes; so that there is no need of having a strict regard to the elevation of the pole, nor any danger of error in making and setting it, as is the case in most other instruments, but the whole is performed with ease and certainty; therefore, 2. Wherever you come, you may easily see the errors of the sun-dials there, and which go truest, and which wrong. 3. As the sun, so likewise may the fix'd stars be seen to transit the meridian; whereby the hour of the night may be as exactly known, as the hour of the day by the sun, if you know the *Right Ascension* of the star that transits; for, as above, for the pole-star, subtract the *Right Ascension* of the sun from the *Right Ascension* of the star, the remainder, converted into time, is the time of that star's culminating or southing; and if 12 hours be added, or subtracted (making due allowance for the alteration of the sun's *Right Ascension* in that time) it shews the exact time of that star's coming to the meridian northwards. 4. The hour of the day and night being thus discoverable by the aforesaid instruments, to 1, 2, or 3 seconds, Mr. *Derham* does not doubt, but that they may be useful in finding the exact differences of meridians, either by the eclipses of *Jupiter's Satellites*, or the occultation of the fixed stars by the moon; Mr. *Derham* does not pretend, that these instruments are any otherwise useful in finding the longitude, than by shewing the exact time of the day or night, which is one thing absolutely necessary in this matter; nor will they indeed serve

serve without a well adjusted pendulum, or pocket-watch, that will keep time exactly from one observation by the meridian-instrument to another; nor are they useful on ship-board, but only on land, where they may remain fix'd; tho' on head-lands, or any where on shore, they may be useful to the seamen; and indeed till better discoveries are made, they may be of service wherever long telescopes can be used, for seeing the appulses of the moon to the fixed stars, or the eclipses of *Jupiter's Satellites*, which is only on land; unless a convenient standing for a man was contrived, and a telescope hung pendulously in a ship, which especially in a calm sea, might be as little subject to disturbance as the pendulums of watches are, which will retain their motion at sea. 5. You may with all exactness continue a meridian-line for several miles, by looking thro' either sight, and observing what objects are intersected by the plumb-lines. 6. These instruments are prepared with little cost or trouble, and easily portable or imitable in any place, especially the latter one.

A further Account of the Pediculus pulsatorius, or Death-watch; by the Same. Phil. Trans. N° 291. p. 1586.

PLATE X. Fig. 5. represents the death-watch as it appears to the naked eye, and Fig. 6. shews it as magnified with a microscope; this insect very much resembles a louse in shape and colour, but it runs more nimbly, it is common in every house in the warm months, but in the cold season of the year, it hides itself in dry obscure places, and is seldom seen.

Some time after their copulation, they lay their eggs in dry, dusty places; where they meet with least disturbance; for in such only, Mr. *Derham* found them; these eggs are exceeding minute, much more so than the nits of lice, tho' lice are not much bigger than this insect is; these eggs are white and shaped like nits, but more transparent; and (like the eggs of all insects Mr. *Derham* ever observed) are hatch'd by the warmth of the approaching spring, which to them is all the same as an incubation; the insect is fully hatched and can creep about the beginning of *March*, or if the weather be warm, sooner; and if cold and unseasonable, later; at their first leaving the egg-shell they are exceeding small; so as to be scarcely discerned by the sharpest eye, without a convex-glass; with a microscope Mr. *Derham* has seen them crawling about, but he could scarcely perceive any hairs, feet, &c. but they rather looked like moving eggs; he therefore supposes, that they were inclosed in their shells, and but just beginning to break out of them; at their first leaving their shells they are smaller

smaller than their eggs, tho' their shells are scarcely visible without a microscope; these young death-watches perfectly resemble mites in cheese; and he could perceive no other difference between them, when much magnified with a microscope, but only that mites have more bristles about the breech; in this shape they continue for six weeks, or two months, feeding on divers things they can meet with; they being so very like mites, Mr. *Derham* could not positively say, but he had great reason to suppose, that they were swarms of young death-watches, which he saw feeding on dead flies, and other things in *March, April* and *May*; and there are scarcely any that escape these voracious, tho' minute animals; from this mite-state they grow gradually to their more perfect state; when they become like the old ones, they are at first very small, and then they can run about more swiftly than when mites, in which state they creep but slowly: Had this insect ever been taken notice of by the ancients (as Mr. *Derham* does not find it was either by them, and but little by the moderns) they would no doubt, have made its production to be like that of other insects, out of dust, or some other thing, wherein its eggs were laid; but as in this, so in the generation of all other insects, yea, all animals, it has been observed, that nature is very regular and uniform in deriving the offspring not from corrupted matter, but from animal parents of the same species; it is surprising to see the procedure of nature, particularly in the generation of insects; as for instance, in what curious and exact order the several species of gnats lay their spawns; the ingenious *Swammerdam* and other authors mention but two sorts of gnats, but Mr. *Derham* has collected near 30 distinct species of them; and he has observed, that one species lay its eggs in this, another in that, and another in a third form; and others in other forms; and he could not but be surprised to see how artificially the spawns are tied in the water, and how, after the sun's incubation, if it may be so termed, the spawn is dissolved, and the eggs, with a part of the jelly, in which they were inclosed, fall to the bottom of the water, and there stick on stones and other things, where they are hatched into *Nymphæ*, as various as the gnats themselves; some being red, green, white or other colour'd worms, and others of quite a different shape; and lastly, how these *Nymphæ* become *Aureliæ*, and then gnats both male and female of every species.

In *Phil. Trans.* N° 271. Mr. *Derham* has plainly shewn, that the ticking noise of the death-watch is a wooing act; and that it is commonly about *July*; he scarcely ever heard them

beat before *July*, but they beat all or the greatest part of that month, and in the beginning of *August*; he heard them tick till *August* the 16th, but never later; but they do not beat alike every year, but sometimes sooner and sometimes later; sometimes much, and sometimes little, according as the year excites, favours, or hinders their venereal inclinations; for he observed, that they tick'd very much in the year 1702, scarcely ever ceasing either day or night; but in 1703 they ticked as little; in both which years Mr. *Derham* observed as great a difference in the fertility of other insects; and no doubt, but the like befel the death-watch; the most perceivable difference was in insects bred in the waters; which he mentions, because it serves to illustrate what he was saying about the death-watch: Now, as to the waters, it might be observed, that in the year 1702, they were exceedingly replenished with *Animalcula*, and you could hardly find any stagnating water without a great many *Animalcula* of several sorts therein, even visible to the naked eye; and if you viewed with a good microscope, but a small drop of water, you might see a great many more; so that the water look'd in a manner as if alive; but in the year 1703, he found some, tho' very few of those *Animalcula*, either with or without a microscope; the *Pediculi aquatici* (which *Swammerdam* calls *Pulices aquatici arborescentes*) which are seldom barren, were less numerous in our waters the summer of the year 1703, than they were the preceding summer, by several myriads; or at least, they were less venereally inclined, or less pregnant; as Mr. *Derham* supposes, from there being vastly less numbers of them congregated together; for the reason of their assembling in such vast numbers, so as to discolour the waters, Mr. *Derham* discovered to be either for copulation, or to discharge their young out of the receptacles wherein they were lodged, or to cast their *Exuvie* or skins, or for all three together; for he has seen all these things perform'd at that time; now, as these very numerous fertile insects, so in all probability the death-watch had its venereal flames abated by the indisposition of the year; and consequently they click'd but little; the reason of all which Mr. *Derham* took to be owing to the wet of the spring months, especially *May* and *June*; in the former of which, there fell more rain at *Upminster*, than in any other month of any year since 1696; so that this vast wet might not only chill, and spoil the eggs of the water-insects, but likewise indispose the air; and by some such means affect all other insects, and render them less prolific; and not only insects, but even corn itself was less fruitful.

After

After that they have spent some time in ticking, they copulate; Mr. *Derham* never found them *in Coitu*, till a week or a fortnight after their ticking; but it is very probable, that they copulate in the time of their ticking, as he had formerly shewn the *Scarabæus* death-watch does: He has seen the old death-watches feed upon dead insects, as the young ones do; as also upon divers other things; viz. biscuit, tallow, &c. nay dust itself; for which reason, probably it is, that they delight most in dusty places, not in all, but such as are fouled with light dust, that flies about in sweeping, &c. but in this their eating dust, there is one thing Mr. *Derham* observed, which to him seem'd remarkable; viz. their curiosity in choosing it; for they do not eat all that falls in their way, but are very nice in selecting what suits their palate best; having seen them turn the dust and hunt amongst it with great pains and diligence; from whence he concludes, that the death-watch, and other animals that eat dust, are not nourished by the pure terrene particles thereof, but rather by more nutritive particles intermix'd therewith; for dust contains very different particles, some of earth, some of animals, some crumbs of bread, cheese, and other provisions, reduced to powder; some particles of fruit, or spittle, snout, &c. dried and reduced in like manner to a powder; now, these very particles of the dust, are doubtless what the death-watch (like ducks in mud) hunts after, when he turns up and dives amongst heaps thereof; nay, so far, probably is his food from being corrupted or fouled by the terrene particles, that it is, perhaps, the better prepared by being thus mixed with dust; for whereas, in the mass it was more solid, and required gnawing and mastication, but now it is in powder, it is ready subtiliz'd, and fit for deglutition; and tho' dust seems to us to be nothing but dirt pulveriz'd, or if it also consists of such particles as have been already mentioned, yet it is so mix'd and blended with dirt, as to be inseparable therefrom; but yet it is otherwise with our insect; for Mr. *Derham* had observed them thro' a microscope, select the particles of dust, and eat some and reject several others; which they can easily do, being small themselves, and having accurate organs of seeing, smelling and feeling, as well accommodated to dust, as the organs of ducks and hogs are to find their food in dirt: Here, Mr. *Derham* cannot forbear observing a common error about the food of such animals, as either have been, or are still supposed to live upon things scarce nutritive of themselves; thus the *Chameleon* was thought to live upon air, when at the same time they eat flies; fishes to live upon water, or at least to satisfy a perpetual thirst therewith, whereas, their sucking

water is breathing, and their food perhaps, as little of water, as other animals use; so earth-worms are supposed to eat earth, but in all probability, it is earth formed of rotten roots, plants, or such nutritive things, and not pure earth; nay, so necessary is good substantial food to all animals on this our globe, that Mr. *Derham* is of opinion, that there is no animal, no not the minutest insects, but what have their proper food, and that none of the four elements is their food, tho' they may be mix'd therewith; of which see an instance of Mr. *Derham's* about the food of *Water Animalcula* in Mr. *Ray's Wisdom of God manifested in the Works of the Creation*. p. 431.

The death-watch abstains from food, Mr. *Derham* supposes all the cold months; for you may perceive them gone very soon into their *Latibula*, or lurking holes, as soon, if not sooner than swallows; where, doubtless they live all the winter without food, as several other animals do; Mr. *Derham* had found them lying deep in undisturbed dust, but never in shallow dust, as if they had a foresight of the danger and inconveniencies of cold frosty weather.

Mr. *Derham* observes, that the answer to a question in the *Athenian Oracle*, where the noise of the *Pediculus pulsatorius* is plainly described, is by no means right; for the gentlemen of that society say, that enquiring into such a noise, they found a little hole eaten into the wall, that with a paper-trap they caught the insect, which they concluded made the noise, and that it was a small sort of spider; but Mr. *Derham* owns, he himself had been so often imposed on in the same manner, before he actually discovered the truth, that he was well assured those gentlemen had been so likewise; for, in pursuing the noise Mr. *Derham* had sometimes discovered a spider near, and sometimes a small *Scarabæus lignivorus*, which eats little holes in wood, and which has been commonly taken for a death-watch; and Mr. *Derham* supposing that these might make the clicking noise, he therefore narrowly watched them; but he found that tho' the beating continued, the insects did not stir in the least, nor were any ways affected; thus still diligently pursuing his enquiry, he at length discovered the real animal; and he had been for so many years so well acquainted with all the noises of the death-watch-kind, that he was assured, there were but two species of them in those parts of *England* where he had been; viz. the few quick beats of the *Scarabæus sonicephalus*, as *Swammerdam* calls it, describ'd by Mr. *Allen*; and the longer and more leisurely beats of that insect Mr. *Derham* has now been speaking of; there are indeed, *Scarabæi*

robæi-grasshoppers, crickets, &c. which make pettular noises; but there are no animals that make these regular clicking noises, like the beats of a pocket-watch, but only that *Scarabeus sonicephalus*, and the *Pediculus pulsatorius*.

An Eclipse of the Moon, observed near the Royal Exchange, in London, on Sunday Morning the 12th of December, Anno 1703; by Mr. Hodgson. Phil. Trans. N° 291. p. 1594. Translated from the Latin.

MR. Hodgson, having got ready a 12 foot telescope, and at four o'clock in the morning raising it to a proper elevation, had then great hopes of observing the beginning of the eclipse; because, tho' the sky was not quite clear, yet the clouds were so thin, that he could easily see the moon's limb, and at times distinctly observe her principal spots; but about 20 minutes after four o'clock, thick clouds arose, which being driven from that quarter of the heavens, between west and south, towards the opposite part, covered the moon in such a manner that he could not see her at all, till 35 minutes after four o'clock, when she came to view again; and then her eastern limb was seen considerably obscured, reckoning three or four minutes after her first ingress into the shadow; but he could not distinctly perceive her spots, in order to determine where she began to be eclipsed, nor in that short time measure the quantity of the eclipse; but four minutes after five o'clock, so far as he could conjecture, the moon's disk was obscured almost six digits; he saw her at intervals, till 35 minutes after five o'clock, when she wanted only three minutes of being totally immersed; but at that time a small, but thick cloud did so cover the moon, that he could see her no more; and tho' he was very intent to observe, if possible, her emerision, yet he could not, both by reason of the gross vapours about the horizon, and the approaching light of the day; Mr. Hodgson saw the moon upwards of 20 times from the beginning, to the time of her immersion; but by reason of the intervening clouds and the short time he had to view her in, he could not pretend to determine any thing with exactness; and tho' this observation cannot be of any great use for examining the lunar tables, yet it may serve to satisfy and convince the curious that they are not very wide of the truth.

A Ball voided by Stool; by Mr. Ralph Thoresby. Phil. Transl. N^o 291. p. 1595.

AN apprentice girl at *Rawden*, four miles from *Leeds* in *Yorkshire*, about 14 years of age, having been afflicted for some time with cholical, and as was supposed nephritic pains, she at length voided a roundish ball *per Anum*, as hard as a stone; after some time, her pains returning with greater violence, so as to make her roll upon the ground; she voided another, as hard and much bigger; upon which one Mrs. *Ward* who had been much afflicted with the gravel, gave the girl some of those medicines she used to take herself, whereupon she voided a third ball *per Anum* with less pain, tho' it was the largest of the three; the first of these balls was smooth and glossy, of the colour of a hazel-nut, three inches in circumference and somewhat compressed; the other two were rough and gritty, and in like manner a little compressed into a kind of an obtuse angled triangle; the second ball was four inches and a half round; and the last was five inches and a half; considering their bulk, they all three were light, especially the two latter and larger ones; the last of which weighed but five drachms and thirty-six grains, and both of them swam in water; this lightness proceeded from the matter whereof they consisted, which in some places was purely downy or fuzzy, in others regularly mixed with a gritty substance; the fuzzy parts possessed the central part of the ball, with a small particle of blackish glass, or other vitrified substance to the very center itself, over which there were several gritty and fuzzy coats, alternately terminating in the circumference with the grit, much resembling the ground-work and superstructure of the oriental bezoar stone; when the powder of one of these balls was scraped off with a knife, it was no ways affected with any sort of liquor dropped thereon, either alkaline or acid; nor did it stink when burnt, and therefore it consisted of no animal substance; but the patient being of the age that girls usually have the green-sickness, the gritty parts (with the glassy particle in the center, as the most ponderous and least moveable) seemed to have been broken off tobacco-pipes, and ground small between her teeth; the downy or fuzzy parts to have been licked or scraped off the lean of mutton, or the rind of peaches, or of some other part or plant; the girl's stomach kneading and concreting the matter into a coat; according as her changeable appetite supplied it alternately with one or the other sort.

An Account of Cochineel; by M. Leewenhoeck. Phil. Trans. N^o 292. p. 1614.

A Merchant of *Amsterdam* observed that it is impossible, and altogether incredible, that the drug called cochineel should be (as Mr. *Leewenhoeck* had asserted) flies, or any sort of animal with wings, head, and feet; not only if we consider, says he, the vast numbers of them brought in every fleet from *America*; but that two of the largest of these particles, eight of the middling sort, and 20 of the smallest, do hardly weigh a grain of gold; so that in a pound of them, at a medium of large and small, we may compute 102400 particles; now in a fleet that carries 200000 pounds of this drug, what a vast number of animals must there be? Besides, continues this gentleman, where can you find men enough, who at the proper season of the year shall catch these insects, and dismember every individual, by pulling off its head, legs and wings, &c. so that upon the whole matter he concludes, that cochineel must needs be a fruit, or the excrescence of some kind of plant.

Mr. *Leewenhoeck* makes an extract of what he had said, *Phil. Trans. N^o 193.* (from an account he had of a *Spaniard* of *Jamaica*, that had lived a great many years in those parts) viz. that there is a certain plant called a prickly-pear, or *Indian-fig*, the leaves of which are round, thick and sharp-pointed; that upon the leaves or twigs of the said plant, are small knobs or protuberances, from whence are produced by the heat of the sun, little worms; that these worms in process of time become flies, resembling cow-ladies, or lady-birds, as some call them, which when arrived at their full growth, are taken in the following manner; to the windward of the plant, in which these animals are found, the natives kindle a fire of any combustible matter (having first spread cloths underneath the said plant all round) with the smoak of which they are presently suffocated; then upon shaking the tree, they catch them in great numbers and with very little trouble on those cloths; after which they spread them abroad in a like cloth, on a sandy place or a stone-floor, where they are exposed to the heat of the sun, till they are dry; that is, till their little bodies are shrivelled up; and they are rubbed between the hands, till their wings, legs, &c. fall off; and then the remaining trunks of the animals are put into shallow copper-boxes, till they become quite dry: The abovementioned plant has no flowers or blossoms thereon; its fruit is of a fleshy substance and red; and if you handle it, when

when it is ripe, your fingers will look as if they were stained with mulberries; some say, that the cochineel-worms feed upon the blossoms and fruit of this plant, which causes their bodies to be of that red colour; and that if you take the seed of the plant or the dead worms, and dry them in the above-mentioned manner, that cochineel is not so good, as when those animals have got wings, and then are smothered: Now Mr. *Leeuwenhoeck*, for his further satisfaction, took several particles of this same cochineel, as well of the largest as of the smallest sort, and having dissected them, he found, that they all had eggs in their bellies, excepting only one that was so exceeding small, that he could discover none; after he had opened some of the largest trunks and separated from each other, the eggs which he took out of their bodies, and counting them as nicely as he could, he judged that there were above 200 of them; and having observed several of them with his microscopes, he could not only perceive a membrane or shell upon most of them, but also an *Animalculum* of an oval shape included therein, and almost as big as the shell that contained it, which seemed very surprising at first, and almost incredible in so small a species of flies, as the cochineel; till by a very nice and long enquiry he was fully satisfied that it was really an *Animalculum* that lay within it; he pursued this his operation with so good success, that he did not only separate the egg-shell from the *Animalculum*, but in some of them he could also perceive their legs regularly folded up against their bodies, and could separate them therefrom, especially, in such as were full grown; nay, in some he discovered even the several joints of the legs; and thus in the space of two days he saw the legs of 100 *Animalcula*: A person must not imagine, that these *Animalcula* have such short legs as the catter-pillars or silk-worms; but those that were unborn had in proportion to their bigness, legs as long as those that were full grown; and as their legs stand close to the head, in that part which may be called the breast; so when the said *Animalculum* lay stretched out at its length, its little legs could be just seen peeping out of the body; the reason of the mistake of such as call these *Animalcula* worms, proceeds from hence, that thro' the exceeding minuteness of the object, they cannot discover with the naked eye, whether the new born insect be a worm or any other sort of animal: Two hundred or more eggs of these animals can lie in so small a compass as a single grain of cochineel; to which if you add the consideration of the great number of blood-vessels lying in so narrow a compass, and that each
egg

egg receives its nourishment and increase, as it certainly must, by a string or artery; yea, and that probably, there are veins in every string for carrying on the circulation of the blood, how can we sufficiently admire the depth of almighty wisdom! The shape of the eggs of the cochineel-fly, is very like that of our hen-eggs: When M. *Leeuwenhoeck* had viewed some of these embryo's, after he had divested them of the membrane, or shell, in which they were shut up, he observed on their heads, a kind of tool or instrument, about $\frac{1}{3}$ part as long as the whole body of the *Animalculum*, and a very slender point at its extremity, something like that instrument which those *Animalcula* have, that are found on currant-bushes, &c. and by which they get their food (according to the descriptions M. *Leeuwenhoeck* formerly gave thereof) and when they have so done, they clap it to their breasts till they have occasion for it again; from whence he infers, that the cochineel-flies do also procure their food in the same manner; to wit, that they have no teeth whereby to gnaw the leaves of the plant, as silk-worms do, but that they only insinuate the said instrument into the leaves, and in that manner get their nourishment; and this opinion seems to be supported by what the *Spaniard* told M. *Leeuwenhoeck*; viz. that these *Animalcula* feed on the blossoms and fruits of the plant, and that by these means they became red; from hence we may conclude, that the insects do not hurt the leaves, fruits, nor even the blossoms of trees, as far as can be discovered; which may also the better satisfy us, that the cochineel-flies do, by perforating the leaves with the above-mentioned instrument, procure both their food and increase: M. *Leeuwenhoeck* having thoroughly soaked some of the smallest particles of the cochineel in water, he found that what he had before taken to be the bodies of the male flies (as indeed we see that in all small flies produced from worms or maggots, as also in fleas and lice, the smallest are always the males) were all females; and that hardly $\frac{1}{4}$ part of them was arrived to their full growth, when their bodies are full of young: This position of M. *Leeuwenhoeck's*, that all the cochineel flies are females, may seem very surprising, and perhaps, not meet with credit with such as maintain, that no animal can be generated without a copulation of male and female; but M. *Leeuwenhoeck* says, they would be of another opinion, had they seen the vast numbers of *Animalcula*, which the summer of the year 1703 infested the leaves of the lime-trees, or those others that were found upon currant-trees, cherry-trees or hazel-trees; all which *Animalcula* brought forth live

young; and these young ones being very small, had their bodies full of other young; and they were all females, and consequently there is no copulation among them; these, when they are full grown, gather wings, so that there is no other change in them, but an increase of bulk, and sprouting out of wings; now, if this be true in these *Animalcula*, tho' they are 50 times smaller than the cochineel-flies, we may easily believe the same of those also; especially, since the hinder parts of all of them are much alike; in confirmation of which we add, that eels, prawns, or shrimps have no males amongst them: When the cochineel-flies are dry, and rubb'd between their hands, the wings are not only separated from the hinder part of the body, as the *Spaniard* observ'd, but likewise the upper part, together with the legs, the wings, and the head; it may be perceiv'd that the lower part or belly of these *Animalcula*, is divided from the upper, by a kind of short string only, no thicker than a hog's bristle; so that one part may be easily separated from the other, especially when the *Animalcula* are dry; now, these upper and lower parts of the body are placed so near each other, that they will easily appear to the naked eye to have been always united; the *Spaniard* further affirm'd, that the cochineel is not so good, till the *Animalcula* have got wings; from whence we might be apt to conclude, that the cochineel *Animalcula* become flying insects all together, like silk-worms, which are all changed, and that in a very short time from reptiles, into butterflies; but the case is quite otherwise with these cochineel-flies, for they do not lay their eggs all together, or in one day; but M. *Leeuwenhoek* rather supposes, that one of these *Animalcula* brings forth at once 20 eggs, or young ones; and so they require above 10 days before they can be deliver'd of all; for after he had taken 200 eggs out of some of the cochineel-flies, he saw exceeding small ones still remaining in the *Ovarium* or egg-nest: In his observations upon the lime-trees, he saw not only several *Animalcula* that had wings, but divers others much smaller, and that in a gradual descent, so far that several of them were hatch'd that very day; and these observations he did not make at one certain season of the year, but he found that they continu'd to hatch, as long as the days were moderately warm; and M. *Leeuwenhoek* supposes it is so likewise with that *Animalculum*, whose lower parts compose what we call cochineel; for when he had compared some of the largest grains of cochineel given him by three different persons with the smallest grains thereof, as far as he could distinguish by his glasses, he found that 15 of the small grains were hardly equal to

one of the large ones; and upon viewing the powder, or dust of the cochineel he had taken out of the bottom of a box, he met with some trunks of those flies so very small, that he judg'd 100 of them did not equal a large grain.

Plate X. Fig. 7. A B represents a grain of cochineel.

Fig. 8. C D E F G is another grain as it appear'd thro' a microscope; C and E F represent the extreme parts, in which an orifice appears, where the string was broken off, whereby both parts of the body were join'd together; the concave bows or circles in D E F G are not natural, but adventitious to the said grain; proceeding only from the drying or shrinking up of the great number of eggs that lie within the *Animalculum*; for if the said grain was well soak'd in water, these concave parts would become convex, and be likewise more obvious to the sight, as well as the stem of that string just now mention'd; but upon taking one of the largest grains, which is also somewhat flat, that part of the trunk will not shrink inwards; the reason of which M. *Leeuwenhoeck* takes to be this, that the *Animalculum* before it was kill'd, had discharg'd most of its eggs.

Fig. 9. H I K shews an egg with its shell or membrane, as it was taken out of a grain of cochineel steep'd in rain-water about 24 hours; in which egg might be seen the young one within, and the shell surrounding it.

Fig. 10. L M N represents an unborn *Cochineel Animalculum*, which M. *Leeuwenhoeck* had separated from the egg-shell with a great deal of pains; it lay with its back to his sight, and in such a position as to shew three of its legs.

Fig. 11. O P Q R S T V shews a small particle of the vessels belonging to an *Ovarium* or egg-nest; where may be seen divers broken filaments or strings, to which the eggs were fasten'd, excepting the large vessel represented by R, thro' which he supposes that several other vessels receiv'd matter for the nourishment and increase of their eggs; S T a string to which the egg T V was fasten'd in the same manner, as other eggs were fasten'd to the other strings before he broke them off; these strings O P Q R S were almost transparent, he could see other small particles in them, when he took them out of the cochineel grain, and separated the eggs from them; but as they began to dry, they assum'd a reddish hue; and when they were quite dry, they became of a light red colour.

Fig. 12. W X Y Z represents another *Animalculum*, which he also took out of its egg-shell, whose legs are to be seen very
T t 2
plainly

plainly between W and X; but he could not see that leg which lies upon the body.

Fig. 13. A B C D is another *Animalculum* divested of the egg-shell, whose legs may also be perceiv'd between A and B.

Fig. 14. E F G H I represents an *Animalculum* which had lain upon a glass for two days; it was not much alter'd by becoming dry; it had but two legs left, the rest being broken off; in this *Animalculum* there appear'd at the extremity of the head, a crook'd part G H, which M. *Leewenhoeck* supposes to be the instrument wherewith it extracts its nourishment out of the leaves of the above-mention'd plant.

Fig. 15. K L M N O P represents some of the blood-vessels, which partly cover'd another *Animalculum* with six legs taken out of the belly of its dam; he likewise saw amongst the eggs he had separated from the *Ovarium*, as also amongst those fasten'd to the vessels of the *Ovarium*, such exceeding small eggs, that 100 of them did not equal a large egg: In all the cochineel-grains M. *Leewenhoeck* had ever examin'd, he found eggs in their bellies, and young ones in those eggs; but in some he found more than in others; and in such whole bellies were very much shrivelled, he found but few eggs; from whence he concluded, that such as had but few eggs in them, had already brought forth a great many young, and that they would not have liv'd long, as happens to all small flies which die soon after laying their eggs: Now, forasmuch, as those *Animalcula* that are found upon lime-trees, &c. have young ones in their bellies, even before they come to half their growth; M. *Leewenhoeck* in order to see whether it was so likewise with the cochineel-flies, took eight of the small ones, which he judg'd did not all together exceed a large grain, such as is represented by A B Fig. 7; and steeping them over night in rain-water, next morning he found but five that had subsided, the other three being so light as to swim upon the water, which consequently, had not penetrated thro' them; out of the first of these small grains that he dissected, he took 11 eggs; in some of which the *Animalcula* were so completely form'd, that he could easily see their legs, besides several exceeding small eggs; in the second he could meet with no eggs that were arriv'd to their full growth; out of the third he took three perfect eggs; in the fourth there were none perfect; in the fifth there were two perfect eggs, tho' still less; from these observations he concluded, that the production of the cochineel-flies happens in the same manner with that of the *Animalcula* upon the lime, currant, plumb and hasel-trees.

As to what the *Spaniard* said farther, that the cochineel-flies are stifled with smoak, as soon as they have gather'd wings, because the cochineel is best then, this is not at all surprizing; because, when the said flies are arriv'd at their full growth, their bodies are at that time most full of eggs; from hence, M. *Leeuwenhoeck* supposes, is chiefly deriv'd that noble scarlet colour; tho' he affirms, that most of the cochineel-flies (as far as he could observe) are kill'd or smother'd before they arrive at their full growth: The *Spaniard* does not tell us, whether they gather the cochineel once or twice a year; the rather, because the islands of *Cuba*, *Hispaniola* and *Jamaica*, from whence it mostly comes, have little or no winter, in comparison of our countries; for those islands lying between 18 and 23 degrees of N. Lat. the sun in their winter is 40 degrees above the horizon; whereas, with us at the same time it is but 14 degrees and a half: If we had as much summer as the aforesaid islands, the *Animalcula* which we call a sort of louse, would so greatly endamage the currant trees with their filth, that there would be no eating the fruit; and yet, according to all appearance, the cochineel-flies are more prolific than these are: The cochineel-flies, in all probability dwell upon the back or under side of the leaves, which defend them from the great heat of the sun in those parts; and as the smoke cannot destroy all those flies, the few that remain multiply very much in a short time: M. *Leeuwenhoeck* had got about a spoonful of powder or dust, together with some sand out of a cochineel box, and he found, that that which appear'd to be nothing but dust, was a great number of very small cochineel-flies, some of which were so minute, as if they had been just hatch'd, and some were gradually bigger than others; there were, besides other small particles which he took to be the excrement of the *Animalcula*; he also saw a great many legs with three joints, some that had but two, and a few one joint only; among these legs, some had claws, which were either white, dark colour'd, or of a light red; he moreover saw some particles, which he judged to be the heads of the *Animalcula*; and likewise other particles of a beautiful red colour, which he suppos'd to be the upper parts of their bodies; in the said dust there were also some few pointed instruments, or rather prickles, no thicker than a single hair of ones head, amongst which there were two or three that were four times thicker than the rest; and these M. *Leeuwenhoeck* supposes to be the sharp prickles, wherewith (as the *Spaniard* tells us) the leaves are armed, because some of them were of a bright, others of a darker yellow.

Fig.

Fig. 16. QRS represents one of the said prickles guarded with a vast number of teeth about it like saws, and no thicker than a hair of the head.

M. *Leeuwenhoeck* could perceive, but with great difficulty, six legs in some of the *Animalcula* he had extracted out of the abovemention'd eggs, dispos'd in such exact order, as may be observ'd in the *Aurelia* of a silk-worm; the reason why he could not discover their legs but with difficulty, was, because the *Animalcula* whilst they were in the egg, were of a dark red colour, and not at all transparent, especially, such as were almost come to their full growth; at the same time he discover'd, that the unborn *Animalcula* had two horns, in which at one time, he reckon'd five joints, and another time he thought he saw more: After these observations, to wit, that the cochineel *Animalcula* are not changed from worms to flies, M. *Leeuwenhoeck* rejects his former positions; viz. that the cochineel-flies have no shields, wherewith they cover their wings; for he had discover'd amongst the cochineel-grains little black shields or *Vaginae*. with a small round red spot on each shield, which he supposes to be the shields of the flies; the *Animalcula*, whose wings are cover'd with shields are all of them produced either in earth or in wood, from whence they receive their nourishment and growth; and had not nature made this provision for them, after they are changed into flying animals, they could not dig out their way, without hurting their tender wings; for M. *Leeuwenhoeck* having found amongst the cochineel-grains, one of the aforesaid shields on the hinder part of an *Animalculum*, and viewing the same more narrowly, he saw plainly, that that trunk or hinder part had no similitude with any of the other grains; now, seeing that all animals from the beginning are made to produce their like, if the young cochineel-flies had been furnished with wings, it would have been in vain, for the reasons above-mention'd; tho' indeed, it is necessary they should have wings, as soon as they are full grown.

M. *Leeuwenhoeck* having sent his friend at *Amsterdam* a duplicate of what he has related here, as also a copy of the above figures; his friend return'd him an answer, wherein he says, that he had also taken 200 particles out of a cochineel grain; but that he could not after the nicest observations, discover any *Animalcula* in the eggs, &c. wherefore he concluded, that what M. *Leeuwenhoeck* calls blood-vessels, are analogous to the same parts which we find in cherries, grapes, &c. and that what he takes for the shell or membrane of the egg, are only the skins that cover

cover the seed; now, tho' M. *Leeuwenhoek* was entirely satisfied, as to his own particular, with the account he had given, and with the figures taken of the cochineel-grains; yet he dissected several others of the largest sort, and took the *Animalcula* out of the egg-shell, and placed them before divers glasses in such order, that he could not only distinctly see the body of the *Animalculum*, with its parts divided into several circles, but likewise the two horns, with the joints wherewith nature has provided all these unborn *Animalcula*, were as plainly visible.

Fig. 17. A B C D E shews the body of the said *Animalculum*, B H, D I and D K the four legs, the two other being hid from the sight, E F represents one of the horns, of which he had a very fair view; the other horn A G was not placed in so convenient a light, and consequently, it is not so well delineated; at the extremity of the horns there were three small hairs, which are likewise represented by F and G.

An Experiment to shew the Cause of the Descent of the Mercury in the Barometer in a Storm; by Mr. Francis Hanksbee.
Phil. Trans. N^o 292. p. 1629.

IN the violent storm or hurricane of wind in November 1703, it was observable, that the mercury in the barometer did not only considerably subside, but upon extraordinary gusts a visible vibration of the quicksilver appear'd; and for the satisfaction of the curious, that high winds can lessen the pressure of the atmosphere, an experiment was made by Mr. *Hanksbee*, giving a demonstration of this phenomenon; Plate X. Fig. 18. the recipient A containing about five quarts, had about three or four times its natural quantity of air compress'd therein by the syphon B B, which for that purpose, is screw'd on at the bottom, within the side of the balon C; the stop-cock D being turned, and the syphon taken off, a small swan-neck pipe E, is screwed on in its place, that fits into a brass socket, which is fixed in a cubical piece of wood F, right against the horizontal pipe G; from the same cubical piece F arises a naked barometer H H, whose cistern lies open to the passage which leads from the swan-neck-pipe to the horizontal pipe aforesaid; likewise from the same piece F, there proceeds another pipe or tube I, parallel to the horizon, leading to another cubical piece of wood K, three foot distant from the former; out of which there also arises another barometer L L, whose cistern is also open to the horizontal tube I, and by that means has a communication with the open cistern of the other; the parts being

being thus disposed, and the stop-cock being turned, the condensed air proceeds strongly thro' the swan-neck pipe, which discharges itself into the horizontal tube G, whose curren-
 cy diminishes the pressure of the atmosphere upon the cisterns of the respective barometers, in such a manner as to cause the mercury to descend two inches at least; and it is observable, that that barometer which is three foot distant from the current air is equally affected, and subsides parallel to the other; it is likewise to be observed, that as the current air is weakened in its force, the weight of the atmosphere does again increase, and the mercury in the barometer gradually ascends.

An Account of Eclipses of the Sun and Moon, observed at Cambridge in New England; by Mr. Thomas Brattle.
 Phil. Trans. N^o 292. p. 1630.

ON the 12th of June 1694, Mr. Brattle went in the morning to the college at Cambridge, about four miles from Boston, where he observed an eclipse of the sun, with a brass quadrant and telescopic sights, the rays of the sun being transmitted thro' one of the said sights, on a clean piece of paper, passed on a plain piece of board, and fastened at right angles about a foot distant from the said sight; he had drawn on the said paper a circle between two and three inches diameter, equal to the sun's disk, and within that, several concentric circles, dividing the diameter into 24 equal parts, whereby he could observe the eclipse to $\frac{1}{4}$ a digit; the room where the observation was made being darkened with blankets; and to render the observation the more exact, and to rectify the watch he took the altitude of the sun with the aforesaid quadrant, before the eclipse began.

By the Watch		Comp. Altitude	Time by Calculation		Difference
h			h		
At {	8 26 37	} Mane	49 31	} ———	2 57
	31 27		48 26		9 47
	38 26		47 20		9 54
			8 16 40		
			21 40		
			28 32		

The eclipse was first perceived at 9^h 25' by the watch, at which time the sun had scarcely been eclipsed a minute, so that

By the Watch		True Time	
h		h	
9 24	_____	9 14	it began
9 32	_____	9 22	about a digit eclipsed
9 48	_____	9 38	full 3 digits
9 57 $\frac{1}{4}$	_____	9 48	about 4
10 06	_____	9 56	near 5
10 15	_____	10 05	full 6
10 33	_____	10 23	about 8
10 43	_____	10 33	full 9
10 47	_____	10 37	full 9 and $\frac{1}{2}$
10 53	_____	10 43	full 10
10 59	_____	10 49	about 10 and $\frac{1}{2}$
11 03	_____	10 53	better than 10 and $\frac{1}{2}$
11 06	_____	10 56	much the same
11 09	_____	10 59	rather decreasing
At 11 10 $\frac{1}{2}$	_____	11 00	$\frac{1}{2}$ sensibly decreased near $\frac{1}{4}$ of a digit
11 14 $\frac{1}{2}$	_____	11 04	$\frac{1}{2}$ nearest to 10 digits
11 25	_____	11 15	full 9 digits, i. e. full 3 digits restored, or the shadow rather within 9
11 29	_____	11 19	8 digits and $\frac{1}{2}$ complet
11 34 $\frac{1}{2}$	_____	11 24	$\frac{1}{2}$ full 8 digits
11 44	_____	11 34	full 7
11 48	_____	11 38	full 6 and $\frac{1}{2}$
11 52 $\frac{1}{2}$	_____	11 42	$\frac{1}{2}$ just 5
0 02 $\frac{1}{2}$ P. M.	_____	11 52 $\frac{1}{2}$	just 5
0 13	_____	0 03	P. M. full 4
0 26	_____	0 16	full 2 $\frac{1}{2}$
0 32	_____	0 22	better than 2
0 41	_____	0 31	better than 1
0 48	_____	0 38	ended.

Observations made of the sun's altitude after the eclipse, in order to rectify the watch.

Time by the Watch		Comp. Alt.	True Time		Differ.
h			h		
At {	3 31 30	_____	45 52	_____	3 21 36
	36 15	_____	46 23	_____	26 16
	38 10	P. M.	46 45	_____	28 16
	46 50	_____	48 19	_____	36 48
	48 10	_____	48 30	_____	38 20

Hence it appears that the watch went about 10 minutes too fast during the whole eclipse, as has been allowed all the way; so that the eclipse began at 9^h 14' Manc; ended at

0^h 38' P. M. ; lasting in all 3^h 24' ; observe, that in the calculation, the latitude of *Boston* was allowed to be 42° 25'.

There happened a lunar eclipse on *February* the 11th 1700, in the evening, as follows; the moon rose eclipsed, and the horizon was so overcast, that Mr. *Brattle* despaired of having any observation, but at half an hour past 6 she came from under the cloud ; and at 6^h 25' he had just a sight of her, and he judged her to be eclipsed about 5 digits at

h.

6 29 The section was equi-distant from *M. Ætna* and *Horminius*.

32 *Palus Maræotis* began to appear.

34 $\frac{1}{2}$ *Palus Maræotis* and *Mons Apollonius* half out.

37 $\frac{1}{2}$ *Palus Maræotis* quite free ; and *Palus Maræotis* and *Palus Mæotis* in the perpendicular.

42 $\frac{3}{4}$ The Shadow near an inch from *Palus Maræotis*, *Mons Horminius* and *Mons Hercules*.

46 $\frac{1}{2}$ *Palus Maræotis* was in the nadir, and that part of *Palus Mæotis* to Mr. *Brattle*'s right-hand was in the prime vertical.

57 The upper part of the section is now and had been for a long time in *Insula major in Mari Caspio* (and the section now perpendicular) and the lower part wheeling about from *Palus Maræotis*.

7 20 Mount *Sinai* first appeared at 22' wholly free.

25 $\frac{1}{2}$ *Palus Maræotis* and *Mons Horminius* nearly perpendicular.

43 The eclipse was over in the telescope, and at

49 To the naked eye.

Mr. *Brattle*'s clock was set by his ring-dial about 9 o'clock in the morning, as exactly as he could judge ; and the observation was made with his 4 $\frac{1}{2}$ foot telescope, with all the four glasses in it.

The observation of the eclipse of the sun, on the 27th of *November* 1703, was as follows :

At half an hour past 8 in the morning, Mr. *Brattle* set his clock exactly by his ring-dial ; and at $\frac{1}{4}$ an hour past 9 they exactly agreed at,

- h 7
 10 00 The sun was not touched.
 00 06 The moon entered on the S. S. W. point as near as he could judge.
 15 The eclipse was considerably advanced.
 20 Seemed to be about $\frac{1}{2}$ a digit eclipsed, rather more than less, and the section a small matter more westward.
 10 25 Much the same, and near the same point.
 30 Seemed to be less.
 33 $\frac{1}{2}$ The middle of the section nearer the S. W. and the diameter of the section less every way.
 37 $\frac{1}{2}$ Much less and nearer the west.
 44 $\frac{1}{2}$ It ended and was just over, going off near the S. W. ; so that all the while it was within a point or two of the place where it first came on, or between the S. S. W. and S. W.

Mr. *Brattle* judged when the eclipse was at the height, that the chord of the eclipsed part was nearly equal to the side of an inscribed decagon, or subtended about one tenth of the periphery of the sun's disk ; he observed this eclipse with a telescope of one joint, four foot and a half long ; and he had only two glasses so that it inverted the object ; and he had a red glass, which he could screw in just before the eye-glass, without being obliged to hold it in his hand, as when he observ'd the sun's altitude with a brass quadrant.

An observation of the eclipse of the moon, on *December* the 12th 1703 in the morning.

Time by the Clock.

- h
 11 45 That part of the moon's disk near *Alabastrinus* looked somewhat dusky, and the eclipse began to enter between *Palus Maræotis* and *Mons Porphyritis*.
 11 53 The true shadow was well entered.
 58 *M. Porphyritis* just covered.
 12 03 $\frac{1}{2}$ Near three digits darkened.
 7 $\frac{1}{2}$ Mount *Ætna* began to be darkened.
 9 $\frac{1}{2}$ Quite covered.
 14 $\frac{1}{2}$ *Lacus niger major* and *M. Sinai* almost equi-distant from the section of the shadow, *Lacus niger major*, being somewhat the nearer of the two.

h

- 18 $\frac{1}{2}$ *Lacus niger major* began, and at 19 $\frac{1}{2}$ was quite covered.
- 21 $\frac{1}{2}$ Mount *Sinai* began to be covered.
- 21 $\frac{1}{2}$ Quite covered, and the moon about 6 digits eclipsed.
- 24 $\frac{1}{2}$ *Besbicus* began to be covered.
- 26 Quite covered.
- 28 $\frac{1}{2}$ *Bysantium* began to be covered.
- 29 $\frac{1}{2}$ Quite covered; and Mount *Horminius* began to be covered.
- 32 *Apollonia* began.
- 33 Quite covered.
- 37 The shadow was equi-distant from Mount *Corax* and Mount *Paropamisus*, or somewhat nearer to Mount *Corax*.
- 39 $\frac{1}{2}$ Between 9 and 10 digits of the moon were eclipsed.
- 43 M. *Corax* began to be covered.
- 44 $\frac{1}{2}$ *Palus Meotis* began, and at 45 $\frac{1}{2}$ the inner part of M. *Paropamisus* began.
- 50 *Palus Meotis* quite covered.
- 51 $\frac{1}{2}$ The moon not quite eclipsed.
- 52 Nor yet.
- 53 Nor yet.
- 54 Scarcely yet.
- 54 $\frac{1}{2}$ Quite immersed and the *Mora* began.
- 14 39 Precisely; and she immersed between *Palus Maræotis* and *Mons Porphyritis*.
- 42 *Palus Maræotis* began to be free.
- 43 Quite clear.
- 47 M. *Porphyritis* quite clear.
- 55 About 3 digits restored.
- 60 59 Mount *Ætna* began to be clear.
- 55 02 That and *Lacus niger major* at the same time clear.
- 8 $\frac{1}{2}$ Mount *Sinai* about half free.
- 9 $\frac{1}{2}$ Quite free, and about 6 digits of the moon restored.
- 30 $\frac{1}{2}$ *Mons Hercules* was free.
- 32 $\frac{1}{2}$ *Palus Meotis* began to be clear.
- 38 $\frac{1}{2}$ It was quite free.
- 41 $\frac{1}{2}$ *Insula major* in *Mari Caspio* free, and in the middle of the section.
- 42 $\frac{1}{2}$ Not yet wholly clear.
- 45 Fully over in the telescope, tho' a kind of a smok appeared some little time after to the naked eye.

In

In order to adjust the time, Mr. *Brattle* set his clock the preceding morning with the greatest exactness he could, both from his ring-dial and from the rising of the sun, which he watched and observed very narrowly; and he found it to agree with the sun's setting the following evening; so that it went during all the time of the eclipse, very steadily and regularly; but for the greater certainty and satisfaction, he took the altitudes of the following stars with the brass quadrant with telescope sights, out of his chamber window, the lowness of which would not permit him to take them at all, when they were elevated higher.

In dextro humero Orionis.

By the Wat.	Comp.	Alt.	Time by cal.	Differ.	
h		"	h	"	
6 6	78	18	6 13 40	1 20	
6 21 $\frac{1}{2}$	77	03	6 20 28	1 02	
26 $\frac{1}{4}$	76	11	6 25 08	1 07	
<i>Præcyon</i>					
8 9 $\frac{1}{2}$	77	20	8 08 04	1 11	
14 $\frac{1}{2}$	76	20	8 13 32	0 58	
21	75	13	8 19 36	1 24	
<i>Regulus</i>					
10 8 $\frac{1}{2}$	77	46	10 07 18	1 12	
17 $\frac{1}{4}$	76	11	10 15 58	1 17	

So that by these observations his clock went nearly a minute too fast.

Mr. *Hodgson* made some observations of an eclipse of the moon, on the 11th of *December* 1704, whereof he gave an account in a former *Transaction*; as follows, the heavens being cloudy the most part of the night, it was 35' after 4 in the morning following, before he could perceive that the moon was eclipsed; and then as near as he could judge, she had been so about 3 or 4 minutes at most; from whence we may conclude, that it began at *London* about 31 or 32 minutes after 4 in the same morning.

Mr. *Brattle* found, that at 44 minutes after 11 at night, part of the moon's disk looked somewhat dusky; and that at 52 minutes, the shadow was well entered; so that from hence, as well as from a comparison of the ingress and egress of the principal spots; Mr. *Hodgson* concludes, that probably it began there about 49 minutes after 11, and consequently that *Cambridge* in *New England* lies $4^h 42' \frac{1}{2}$, or $70^{\circ} 37'$, to the westward of the meridian of *London*.

Mr.

Mr. *Hodgson* happened to see the moon the same morning at 35 minutes after 5; when she wanted at most but 3 minutes of being totally eclipsed; so that at *London* she immersed at 38 minutes past 5.

Mr. *Brattle* saw her immerse exactly at 54 minutes after 12; whence it follows, that the difference of the meridians found by comparing these observations, is $4^h 43' \frac{1}{4}$, or $70^\circ 52'$, agreeing very well with the former; so that by taking a mean between them, the difference of longitude of the two places is $4^h 43'$, or $70^\circ 45'$; Mr. *Hodgson* saw no more of the eclipse that morning; and he from hence concludes, that the mutual agreement of these observations gives great reason to believe that the deductions are good, and may be relied on.

Concerning the Flesh of Whales, crystalline Humour of the Eyes, &c. by M. Leewenhoeck. Phil. Trans. N^o 293. P. 1723.

M. *Leewenhoeck* had often concluded, that the globules of blood (which are the cause of its redness) are of the same magnitude both in large and small animals; and consequently that the particles of blood in a whale are of the same size with those of other fishes; but not being able to get at any whale's blood, he was obliged to acquiesce in bare speculations; from the particles of blood in a whale, he was led to consider those of the flesh, imagining that the fleshy particles of the said fish were no bigger than those of a horse or cow; and that the bulk of a whale consisted only in the great number of its particles; M. *Leewenhoeck* having cut a-cross a piece of whale's flesh, (that was brought him by some concerned in the *Greenland* fishery) in order to separate the particles lengthwise; he could discover no difference, as to appearance, betwixt the said particles and those of a large ox; the reason why he compares a whale with a large ox is, because he takes the fibres in a large ox to be no more in number, than those of a small one; nay even in a calf he supposes the fibres are not fewer in number, only they are not so large.

M. *Leewenhoeck* had the crystalline humour of two whales, a large and a small one. Plate X. Fig. 19. A B represents the smaller crystalline humour, when it came to his hands, tho' he supposes, it was somewhat larger when taken out of the whale's eye; for, he observed, when he took the crystalline humour out of a cod's eye, and laid it down never so gently, by reason of its softness, some of its substance fell out, which having viewed with his glasses, he could still discover therein the fibrous matter of

of which it consisted; in examining the said crystalline humour, (which the sea-faring people mistake for the whole eye, and so shew it for an uncommon sight, that so large an animal should have so small an eye) it appeared to him, that the fibrous matter or particles whereof it was composed, were so very thin, making such exceeding fine scales, that lay so very close upon each other, that it was a surprising sight; and this fibrous substance is thinner of particles than that of a perch not a year old; the reason why the fibrous matter of the crystalline humour of a small perch appears thicker than that in a whale is, because we see the former on one side, where the threads or fibres are thickest; but if we view them where the fibrous particles meet together, they are exceeding fine and slender; whereas, on the contrary the fibrous matter of the whale not meeting together, but often crossing is of the same thickness throughout: M. *Leeuwenhoeck* discovered, that the crystalline humour in a whale, is of a quite different texture or circumvolution from the fibrous matter in several animals; for whereas, the said humour in others consists of three particular conjoined branches, all arising from one point, the same humour in the eye of a whale is composed of five circumvolutions all which unite in one point, and make one scale; but here M. *Leeuwenhoeck* only means the half of that orb of the crystalline humour which fell immediately under his observation.

Fig. 20. CDEF shews a small particle of the crystalline humour of a whale's eye, taken off from the globular part; the largeness of which as it appear'd to the naked eye, is represented by GH in Fig. 21; and when he dissected the second crystalline humour as in Fig. 21, he could very easily perceive the exact circumvolution and texture of the fibres, notwithstanding the scaly particles were dried together so hard, that they were as clear as glass; the abovementioned little particle represented by Fig. 20. CDEF appear'd to the naked eye no bigger than IK Fig. 22. in which, with his microscope he could discover the exceeding fine threads, which he calls the fibrous matter, with a part of the circumvolution, which compose a fifth part or division of the hemisphere of the said crystalline humour; these scaly particles lying no thicker on each other, than the threads or fibrous matter as represented in Fig. 20, how closely must they then be united; for otherwise, it would be impossible for the crystalline humour, to have such a transparency, as the nature of that body requires: In order to give a clearer idea of the texture of the fibres in the crystalline humour of a whale's eye, which lie in so many folds upon each other, M. *Leeuwenhoeck* took a common ball, and dividing

viding it into such parts as are analogous or correspond with the divisions of the fibrous matter in the crystalline humour, he then wound it round with a single small thread, which was to represent the fibrous matter that composed a small scale of the said humour.

Fig. 23. A B C D E F G H I K represents the globe or orb of the crystalline humour of a whale, whereof L is the center or axis, and lies next to view, where the fibrous particles arise out of the shortest circumvolution of the opposite part of the globe, the course of which is in some measure shown by the letters L A, L O, L E, L G, L I; as for the fibrous substance which here first circumvolves from the middle point or center, viz. Q B, P D, O F, N H, and M K, they describe the same circumvolution in the opposite part of the sphere or globe, which is here represented by L.

Fig. 24. R S T U represents the said ball so well wound up in the single thread, that there only appear'd the two extremities of the said thread, and hardly any of the leather of the ball; the center or axis which in Fig. 23. is represented by L, where the fibrous matter circumvolves five several ways, as A L C, O L E, E L G, and G L I we must suppose to be represented in this figure by R and T. Here the unconceivable wisdom of the great Creator of all things is very obvious; for what man is there in the world, that could wind a ball or globe about with a single thread of equal size throughout, and not cross it in any point, as is the case in the contexture of the filaments, of which the scales of the crystalline humour of a whale are compos'd.

M. *Leeuwenhoeck* having carefully observ'd the eyes of several fishes, and particularly the *Tunica cornea*, he found that the said tunic, or rather the pupil or apple of the eye, was very flat, like those in human, and other animals; from whence he concluded, that tho' the crystalline humour in fishes was spherical, yet that was compensated by the flatness of the apple of the eye; consequently, one might probably conclude, that the eyes of fishes are of the same contexture with other land-animals, and that the effects in both are the same; for the *Tunica cornea* in men makes a circle, whose axis is an inch long: Upon taking the eye out of the head of a live cod-fish, and putting the *Tunica cornea* into several copper globes, it appeared to M. *Leeuwenhoeck*, that the protuberant roundness of the said tunic, was equal to the segment of a circle, whose diameter is two inches; the eye was a little prominent out of the head, like those of other animals; and tho' the tunic or apple of the eye in other animals forms a larger circle,

circle, yet it is not bigger; M. *Leewenhoock* found that the axis of the crystalline humour in the said cod-fish was a little longer than $\frac{1}{4}$ an inch; now, if the crystalline humour (which he has sometimes call'd the crystalline muscle) in our eyes, and in those of several other animals, consists of a flattish roundness, and not perfectly spherical; and if the diameter of the circle form'd by the tunic of the said eyes be an inch long; the crystalline humour in fishes being spherical, and their tunic describing a circle, whose diameter is two inches, all these eyes may have the same effect: After this M. *Leewenhoock* took a whiting, which weigh'd about nine ounces, and examining its eye, he found that it describ'd a circle of one inch and a half in diameter; and the diameter of its crystalline humour was very near $\frac{1}{4}$ of an inch; When he dissected the crystalline humour of a small fish, and found the innermost part thereof no bigger than a large grain of sand, he observ'd that the fibrous particles, of which those exceeding small scales were compos'd, did consist of as many parts as the uppermost scales of the same humour.

A certain gentleman asking M. *Leewenhoock*, why nature had furnish'd us with eye-lids, seeing that fishes have none; he answer'd that it was absolutely necessary for us, and all land-animals to have eye-lids; for if it were not so, and that the apples of our eyes were not moisten'd several times in the space of an hour; and all the filth that might fall thereon, wash'd away, our sight, or the *Tunica cornea* would be so clogg'd, that we should not be able to use our eyes; besides, the said *Tunica* would otherwise be parch'd or shrunk up with heat, and consequently we should become blind; whereas, on the contrary, fishes always living in water want no eye-lids, because, the same water keeps their eyes still moist and clean; but M. *Leewenhoock* had since found, that he was mistaken in his assertion; for, flounders, plaice, soles, and he believes all flat fishes can cover their eyes; and if they could not, he supposes they would lose their sight, because, the said sort of fish are not so nimble as others in swimming, being only able to move their tails, their chief instrument of speed, upwards and downwards; wherefore, these fishes in a storm do not betake themselves to the bottom of the sea, as he was inform'd, but dig themselves holes in the sand, which secures them from being thrown upon the beach or strand; now if they had not eye-lids, the sharp points of sand, whilst they are making their beds, would wound the tunics of their eyes, whereby the transparency thereof would be destroy'd, and consequently these fishes

fishes would become blind; which is an additional proof how perfect every creature is in its own species.

The Tubes or Canals that convey the yellow Sap in Aloes-leaves; by the Same. Phil. Trans. N^o 293. p. 1730.

M. *Leewenhoeck* first observ'd the external skin or membrane of the leaves of aloes, to discover if possible, of what tubes or pipes they were compos'd; but he could not find out the conjunction of the parts; because, that membrane was so weak and tender, that it always broke without any remarkable discovery; in this disquisition *M. Leewenhoeck* observ'd, that there lay in the said membrane roundish particles, that look'd like little bladders; and in these bladders there were green particles, containing a sap in them, and they lay as it were in a right line, and so interwoven with each other, that they serv'd as he suppos'd, for tubes or canals; the impressions of these round particles were in several places so regular, that each consisted of six sides, dispos'd in the exactest order imaginable; and in each particle might be discover'd a protuberance; and they were separated from each other by rings or circles, which he suppos'd to be the canals.

Plate X. Fig. 25. A B C D represents a small part of the said hexangular particles, as they appeared thro' his microscope; where some of the canals are, to distinguish them the better, shewn outwards as at A B C D; upon farther examining the aloes-leaf, he discover'd another sort of canals or vessels, in which the sap appear'd somewhat reddish; he took the sap out of the said vessels, to try whether there were any salt particles therein, and what figure they were of; he let this sap lie a little, that some part of it might evaporate, and that the salts might coagulate, and placing some of it before his microscope, he observ'd a great number of long slender particles, that lay in the sap, and were sharp or pointed at both extremities; and forasmuch, as he suppos'd, that these long particles could not be coagulated in so short a time as the sap had been press'd out of the canals, but rather that they were there before, he endeavour'd to bring the said long particles out of the vessels, so as that there should come but very little sap with them; which happening accordingly, a few of them are represented in Fig. 26. E F G H; the said slender particles appear'd thro' the microscope very clear and transparent; he laid them upon a clean glass-plate, and viewing them about three weeks after, he was surpris'd to see that some of them had assum'd a peach colour, especially such as lay loose, or upon each other; after

after several observations, by breaking and cutting into pieces the aloes-leaves, he not only placed so nicely before his glasses the aforesaid long pointed particles, that they could be seen lying in those rings or circles, which he suppos'd serv'd for canals, as in Fig. 27. I K L M, in the middle of five rows between F and K; but he also separated a small piece of the leaf in such a manner, that the extremities or points of those sharp particles stretch'd themselves beyond the canals, as is here represented in N and O; these sharp particles lay within a small compass, like little bundles, as is shewn in the figure; but they do not all lie in such order, nor always so close to each other; but in several places at a greater distance, and sometimes indeed closer; it is to be observ'd, that Fig. 27. I K L M, as it appear'd to the naked eye did not lie in a greater compass, than a large grain of sand; from whence we may conjecture, what a vast number of such particles are included in one aloes-leaf; in each of these particles in this figure are a great many parts, which seem to be canals; and moreover he supposes, that each circle, or the membranes thereof, in which the sap and other parts are shut up, are also full of canals.

Fig. 28. A B C D E F G H I represents one of the vessels or canals, which lie somewhat deeper in the leaf, and are in a manner surrounded and involv'd in a sort of viscous or slimy matter, which M. *Leeuwenhoeck* endeavour'd to separate from it; from these vessels or canals in four distinct places (and all in a very little compass) there issu'd a kind of branches; as two between D E and F G, and two between H I, which run a-cross from the leaf; these twigs or branches unite again in one vein or canal that lies just by them, which is not near so large as the first mention'd canal; and this union or conjunction is represented by K L M N O P Q R, and there are three such small canals to a large one; yea, the said vein or canal that runs a-cross, is not only join'd to a second ascending vein, which extends itself the length of the leaf; but it goes farther and falls into a third canal, which also runs the length of the said leaf, as may be seen in the same figure by S T V W X Y Z a; and who knows, if one could investigate the conjunction of the vessels, but that this order runs thro' the whole leaf; M. *Leeuwenhoeck* suppos'd, that some of these veins or canals were compos'd of long particles, that extended themselves in parallel lines, and very near each other, but in a winding and serpentine manner; to the end that the said veins might never fall in with each other, but always remain open and distinct; and agreeably to this opinion, he sometimes but very seldom, took those parts out of the canals; in the said Fig. W B C D E F X

represents the last mention'd particle, which composes a canal, but of a very small length, and it seems to be of a flattish shape, as between W and B; but viewing it more narrowly he found that the seeming flatness was occasion'd by the canals lying so close to each other; for he plainly saw that B when stretch'd out, was two distinct canals, as in B C F; and that one of these canals was again subdivided into two more, as from C to D; and perhaps, these slender particles D and E were further subdivided; now a person cannot see these last mention'd parts by cutting the leaf thro', without tearing it in pieces; and then for the most part these canals with the aforesaid particles are also broken; M. *Leeuwenhoek* view'd those winding particles, that lie in the canals or vessels of other leaves, which are so exceeding minute and fine, that it was as much as one could do, with a sharp eye and a good glass, to perceive their serpentine meanders. After this, he took that particle of the aloes-leaf, which he had before examined lengthwise, and cutting it a-cross, he view'd it in that position, in order to discover the orifices of those canals, that in Fig. 28. are represented in their whole length by A B C D.

Fig. 29. H I K L represents (thro' a microscope that did not enlarge the object so much as that thro' which he view'd Fig. 25, 26.) six large tubes, which shew themselves in the last mention'd vessel or canal, in which also there are a great many other smaller pipes; these smaller pipes, which are to be seen about H, have other cross canals that issue from them, from whence proceed the large internal membranes, with the sap therein.

Fig. 30. M N O represents other canals that were also cut a-cross; and by P Q R in Fig. 31. is also shewn, how out of the canals so divided, the membranes proceed, in which most of the sap is included, and of which the greatest part of the aloes-leaf is compos'd; and these membranes with the sap lying therein, are so clear and transparent, that you can see nothing but their circles or circumferences, as in Q R S T V W X P; between these membranes there are canals, but these are very few, with their branches that run the length of the leaf, from whence also the membranes proceed; and when he took one of these canals surrounded with membranes, and the matter shut up in them, and separated a little of it from those other before mention'd parts, and expos'd it to the open air, it presently after assum'd a red colour; whereas, those parts that were invol'd in their membranes, retain'd their colour, which was a little upon the green; this change from green to red, M. *Leeuwenhoek* observ'd several times

in the eggs of a live crab, which he took out and broke into pieces, and upon viewing them, he perceiv'd that the matter which lay in the egg-shells was green; but when he let it dry a little, it presently turn'd from a green to a red: He cut a cross the great canal of another aloes-leaf, which appear'd yellow, as also did the sap which came out of the internal membranes; and upon cutting a slip or slice of such a leaf, which was as thick as the back of a knife, and laying it upon a clean glass-plate, it presently became of a peach-colour; and so did a small drop of the sap upon the same glass; which being almost dried up, there appear'd so many salt particles in that little matter, as if the $\frac{1}{4}$ part of it had been mix'd with a shining sand: He took a little of the aforesaid sap, and putting it on his thumb-nail, and letting it dry there, he observ'd, that it had left a yellowish colour behind it; and that the particles of salt had coagulated upon his nail, in the same manner, as a foggy moisture is congeal'd in winter on glass windows; and next day he perceiv'd a reddish colour where the sap had lain; and where it had been thickest the red was deepest, being what we call a peach-colour; he tried the same experiment upon two other nails of his hand, and the success was the same, and the colour lasted several days; he cut a little splinter of the wood, in which there had been some of the aloes-sap, but where there was at that time but little colour to be seen; and placing it before his microscope, he saw that it gradually assum'd a peach-colour, which was in some places as bright and as fine as ever he saw; cutting off a slice of the aloes-leaf from its thickest part, as ABC Fig. 32. which letters represent the side of the leaf, that as he supposes, was next the plant; and CDA the other side, which a person would take to be the back of the said leaf; that part of the leaf, which we may look upon to be the skin or rind, and in which the parts represented in Fig. 25, 26, 27, 28, are for the most part shut up, is the space describ'd in Fig. 32. between BF or DH; and between EFGH lies the abovemention'd slimy, or viscons substance, in which he could not discover any vessels that run thro' the middle of it, like those which proceeded out of the large canals, and spread themselves to the innermost parts of the leaf, and were exceeding small and numerous.

M. *Leeuwenhoek* placed another slice of the aloes-leaf (which was also about the thickness of the back of a knife) upon a clean glass, and viewing it several times, being of a fine peach colour, he observ'd therein a kind of oval figure, that lay in an exact order,

order, with its sap shut up in it, after it had been dry about three weeks.

Fig. 33. DEFGH represents the said oval membrane; F I G that part he calls the canal, by which he also supposes, that it receives its increase and inward matter; in this figure may be seen a great many fibres, which he concluded it had borrow'd from other membranes, both from those that lay upon it, as from those that lay under it: Now if we consider, that these membranes cannot be coagulated by the air, since they are not form'd by every evaporation, or exhalation of the moisture; but that such membranes must without doubt, be compos'd of a vast number of fibres, so small as to escape our sight, we have fresh cause to be surpris'd at the unconceivable wonders shut up in such a leaf.

Fig. 31. R P A B C S Q R represents a small particle of what M. *Leeuwenhoek* calls the rind or bark of the leaf, as it was cut off a-cross between D and H in Fig. 32, and dried up irregularly; which part, with S Q R P A lay inwards, as represented by H in Fig. 32; and in Fig. 31. lay on the outside of the leaf, as is shewn by B C; now these parts which in Fig. 31. are cut a-cross between A B and C S, are the very same parts which in Fig. 27. I K L M are represented lengthwise, only with this difference, that Fig. 31. was delineated from a less magnifying microscope: A person would judge that most of the above-mention'd parts are compos'd of roundish membranes, that include a sap, mix'd with exceeding small green particles, so united with each other, as that there is no intermediate space, excepting that which appears to be canals: He squeez'd out some of the sap of the aloe-leaf, and placing it several times upon his escrutore, he always observ'd, that when the water was for the most part evaporated, there remain'd behind abundance of salt particles, which were almost all of them of a quadrangular figure, and of a cubical thickness, as represented in Fig. 34. between I K; and again some smaller, as in Fig. 35. between L M; and others still smaller as in Fig. 36, 37; nay, some of them were so exceeding small, that they almost escap'd the sight, even thro' a microscope; insomuch, that a person could not judge whether these salts were round or square; M. *Leeuwenhoek* also observ'd some figures of salt compos'd of several coagulated together, in such a manner, that their figure could not be describ'd; and amongst the rest there was one salt particle compos'd of four others, join'd together like a cube, as represented in Fig. 38. between N and O; he likewise observ'd, another salt particle compos'd of 20

qua-

quadrilateral ones coagulated together; to wit, five in length and four in breadth; and in another he reckon'd 30 particles, conjoin'd in the same manner: When he took the sap out of an aloes-leaf, whose vessels contain'd a yellow liquor, he observ'd the salt particles lie so clear, as if they had been little pieces of glass; and forasmuch, as they were surrounded with a fine peach-colour, it was a very agreeable sight.

From his observations on the said salts, he was led to consider the aloes itself, as it is us'd in the apothecary's shops; he took a piece of aloes, and beating it small, he wrapp'd it up in a paper, and putting it into a clean glass, he pour'd rain-water thereon, in which he let it infuse for two or three days; then pouring off the top, and causing it to evaporate, he discover'd a great number of salt particles, of the same figure and proportion as those represented by Fig. 35, 36, 37, 38; there were also coagulated a great many salt particles, of the same figure with those represented by Fig. 26. EFGH, only with this difference, that they were somewhat thicker, and shorter in the middle; and some of them not so even or smooth as those in the said figure.

M. *Leewenhoeck* had a small plant of *Lapathum sanguineum*, or dragon's blood, in which he view'd the stalk of the leaf after he had cut it a-crois, and at the same time he discover'd several colours of a light, and of a deeper red; and in the same stalk he observ'd little places wherein he could perceive no colour; but upon cutting the same stalk lengthwise, he could then see that those places were canals, thro' which he concluded, that the red sap pass'd; and that those several colours, which lay in the canals were a sort of bags, that contain'd the sap; and that the said colours were entirely produced by the sap, that ouz'd thro' the sides of the canals, and so made the whole stalk red.

Concerning Tobacco-ashes; by the Same. Phil. Transf. N^o 293.
p. 1740.

A Certain gentleman gave M. *Leewenhoeck* a small quantity of tobacco-ashes not thoroughly burnt, and which he had sav'd out of his pipe; a part of which M. *Leewenhoeck* put into a glass-tube, and pour'd rain-water thereon; after he had mix'd it well with the water, and the ashes had subsided, they took up one part of the tube, and the water stood two parts more above it; altho' these ashes were of a grey colour, and all the particles thereof appear'd to the naked eye to be entirely burnt; yet he could perceive after mixing the water, that there remain'd some exceeding small particles of tobacco, that were not turn'd into the

the colour of these grey ashes; after that the water had stood 24 hours upon the said ashes, he took a little thereof, which to the sight appear'd very clear; but when he observ'd it with his microscope, he saw that it was impregnated with a great many small particles, which were about the same weight with the water, for they neither subsided to the bottom, nor emerged to the surface of the water; he view'd this water with five distinct microscopes, to observe what salt particles were in the water, after it was evaporated.

Plate X. Fig. 39. A B C represents three distinct salt particles, which tho' they were hexangular, and as transparent as if they were made of glass; yet their sides rose into pyramids, just like crystals polished into six sides, all terminating in sharp points, only with this difference, that the superficies of A appeared with six equal sides; but tho' there could be no superficies discovered in B and C, yet that which appeared but with one point, he does not question, might also be hexangular; amongst these salt particles there lay a great many others, wherein by reason of their exceeding smallness, their form or shape was not to be discovered, excepting some of the largest of them, which he could just perceive to be hexangular; and in all his observations he found such particles amongst divers sorts of salts; he also saw a few other hexangular, salt particles, but quite flat, as represented by E F Fig. 40. near which lay another kind of salt, as shewn by G H Fig. 41; he also observed several salt particles like I K Fig. 42. only with this difference, that they had two sharp points at I; he likewise observed several regular square salts, and one also that at first seem'd to be of the same figure; but, upon viewing it narrowly, he found that it had two obtuse angles, as in Fig. 43. L M; there were several other salts, which a person would take for quadrangular figures, seeming to have two long and two short sides; but upon viewing them more nicely, he also found them to be hexangular, as in Fig. 44. N O; other salt particles appeared like equilateral triangles, the angles of which were cut off, and which in one particle appeared larger than in others, as in Fig. 45. P Q; one salt particle represented an oblong cube, as in Fig. 46. R S; he also saw several salt particles, some of which were larger than others, as indeed all the rest of the salts were, which appeared like V W Fig. 47, 48; there were likewise some salts, but very few, that were quadrilateral; and at one extremity the angle was acute, and at the other obtuse, as in Fig. 49. X Y; he likewise observed several long and slender salts, that appeared like Fig. 50. Z Z, which were so closely linked to each other, that

one would be apt to take them for one single particle; but viewing them more narrowly, they appeared to be several linked together: Moreover, M. *Leeuwenhoeck* tried these ashes three several times in a strong fire (after he had kept them in a small wooden box) to see what volatile salts could be extracted from them; and he always observed, that first a very clear liquor exhaled from the ashes; which at the last evaporation was accompanied with a yellowish oil, coagulated in such a manner, as if it was mixed with salts; he also saw a great many small watery particles, which might be called a spirit; and a vast number of small bubbles, which he judged to be oil, some of which were so much smaller than others, that they almost escaped the sight thro' a good microscope; there were, moreover, on the sides of the glass some very small particles, that were neither water nor oil, which he supposed to be volatile salts; but not being able to discover any exact figure in them, he can determine nothing certain about them; he likewise always observed, that when he brought the glass where it was covered with the tobacco ashes, to such a strong fire, as would put it into fusion, the ashes, or rather the salts thereof, united with the glass, and the glass ascended with air bubbles; and with a still stronger fire there was a hole made in the glass.

M. *Leeuwenhoeck* took several times a small piece of *Delft* earthen-ware, which was but once baked, and consequently not glaz'd; and making a small cavity therein, so as to serve for a test or shell, such as the refiners with bone ashes use, he put into it a little bit of gold or silver, together with some lead; and setting this shell upon a large piece of lighted charcoal, such as he judged sufficient for his purpose, and blowing the flame of a lamp thro' a pipe, he made the lead evaporate, but the gold remained behind; yet, it sometimes happened, that the melted gold or silver had made such a deep pit in the earthen shell, that he was obliged to make use of another, in order to clear it of all the lead; after he had evaporated the above-mentioned lead, he put a little tobacco ashes into one of these earthen shells, and in the space of two minutes, with a strong flame of a very thick tallow candle, most of the ashes was turn'd into small globules, and the remainder was in a manner nothing but salt; after this, taking three parts of a certain small quantity of the said tobacco ashes, and proceeding therewith as he had done before, after the space of a little more than two minutes, he took off the shell from the fire, and he found that the remaining ashes weigh'd a very little more than two parts; and

that the shell, on that side that was most exposed to the fire, was turned into a glassy substance; he put the ashes thus prepared (which rather looked like petrified matter than ashes) into a clean glass, and poured water thereon; and stirring it several times about with a copper-wire, he let it stand 24 hours, and then he decanted off what appeared settled and clear to the sight; of which having put a very small quantity upon a clean glass-plate, and viewing it thro' several microscopes, he always observed in a little time after, a great many coagulated salt particles, that were neither flat nor slender, but most of them as thick as they were long, and almost each of them of a particular shape, which was a very agreeable sight; but he found none like those represented by Fig. 39, 40, 43; amongst these there lay some salt particles so very small, that he could not discover their exact figure, tho' he had used never so large microscopes; yet, he was satisfied, that they were salt particles extracted from the tobacco-ashes; he also observed, that upon some ashes which were not mixed with the water, there lay a white substance, which he imagined to have sunk and descended leisurely, because it lay higher in the middle, than towards the sides of the glass; and he took this white matter to be coagulated salts, which being heavier than the water, had subsided upon the rest, and so he found it to be; for when he took it out of the water, and view'd it with the microscope, he saw a vast number of salt-particles, each of a particular figure, and as clear as crystal; tho' they appeared smaller to his sight than those which he caused to be delineated: Moreover, M. *Leewenhoek* took a new blown glass-tube, and putting into it a little of the last mentioned water (after it had stood three days upon the tobacco ashes) he viewed it with his microscope, and saw two particles therein, which he supposed to be salts; whereupon, pouring out of the tube a drop of water no bigger than a large grain of sand (which spread itself so much upon a glass-plate, that there did not remain above one fourth part of it that could be seen) he discovered therein several long particles, which resembled very much the hair of the beard of two or three days growth; he discovered these particles in about the space of a minute; whereas, he saw nothing before but a fluid clear water; and after the space of another minute, the said particles were increased to the number of 30, some of which floated up and down in the little moisture, and were grown thicker and broader; especially, such as lay at some distance from the rest; and some were so thick and broad, that they far exceeded the others in largeness; and when almost all the water was ex-

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hal'd, he saw a great number of very small particles, in which he could discover no figure; because all the salt particles were surrounded with a watry moisture which did not evaporate: Moreover, he took the glass wherein the tobacco ashes were, that he had reduced to a petrified substance, and held it over the flame of a candle till the water boiled, for the space of two minutes, when the said substance was several times lifted up in the water, expecting that the salt particles should be dissolv'd by the said heat and incorporated with the water, wherein they lay coagulated like cubes, but he could not bring it to bear; the salts being link'd by hundreds together, either subsiding to the bottom, or sticking to the glass; all these coagulated salts were so small, that let him use what microscope he would, he could not fully discover their figures; which however, he took to be hexangular; and the rather, because he supposed them all to be of the same bigness; nor could he, as before, see one salt particle in so great a number, bigger than the rest, tho' the water had stood some days upon the ashes; thereupon, he poured the water and the ashes together from the tube, and caused the water to evaporate leisurely over the fire; and laying the remaining ashes upon a piece of earthen-ware, he made it red hot; and when it had cooled, he crumbled it to pieces between a piece of paper; then putting it into a new glass, and pouring a little water thereon, he expected to find that the salt particles would be dissolved by the force of the fire, and united with the water; whereupon, he renewed his observations, pouring off the water leisurely, to the end that the great number of salt particles, in the evaporation of the water, might not coagulate too fast, and so hinder an exact view of them; and he observed several times, that the salt particles, tho' exceeding small, were hexangular, as in Fig. 40. E F; but some of them were longer, than others, and some much larger; and some again were so slender, that he could not have seen them, had not their circumference been thicker and brighter than the rest: Hereupon, he again took a little tobacco-ashes, as clean as they came out of the pipe, and mixing them with pure rain-water, he found the same effect in the coagulation of the salts as before, tho' amongst the said figures of salt he discovered several others; he concluded, that all that were not hexangular were of another figure, by reason of the coagulation, or inclination of the salts to each other; which happened more in some places of the water than in others; whereby the salts assumed a figure that was not proper to them: After that the water had stood six hours upon the tobacco-ashes, which he had twice put into a glowing

heat, he observed a great many cubical salts of several figures, that were coagulated in the water; whereas, he could see but two such salt particles in the water poured upon the tobacco-ashes, just as they came out of the pipe; M. *Lewenboeck* made this last experiment in very moist weather, when the salt particles did not only coagulate, but were also so tenacious of their figure, that he scarcely ever observed any salts extracted from burnt matter, so stubborn and strong as these were: He put the glass a second time over the flame of a candle, 'till the water actually boiled; and then viewing it, he saw some large particles that were very dark, and surrounded with abundance of very small particles, whose figures he could not discover, no more than he could of several other small particles, which he supposed to be salts.

Cuculus lævis cæruleo-flavescens, cui in supremo capite bronchiarum opercula; or the Yellow Gurnard; by Dr. Tyson. Phil. Trans. N^o 293. p. 1749.

IF we may justly infer the identity of species in fishes, from the likeness of their fins, we have then some ground to conclude, that this fish (the Dr. gives an account of, and which had not hitherto been described by any) ought to be referred to the gurnard kind; however, the Dr. not finding any other species it agreed with better, and having no name it was called by where caught, which was about *Hastings* in *Sussex*, he takes the liberty to call it the yellow gurnard; and that he had some colour of reason for so doing, will appear, after comparing this fish with the red gurnard, and shewing wherein they agreed or differed; and first of all, as to the general shape of their bodies, he found that they agreed well enough; in both, the head was the largest part; the body thence still gradually lessening and becoming more taper, as it approached the tail, where it was very small in both; the yellow gurnard measured 11 inches in length, whereof the tail was two inches; the girth of the head was four inches and a half; the fins as to number and situation on the body, were exactly the same in both; he, therefore only takes notice how they differ in other circumstances; as in the fore-fin on the back of the yellow gurnard, there were four or five *Radii* or spines; whereof the first was six inches long, and the next about two, the others shorter; in this fin in the red gurnard were six strong bony spines, sharp pointed, whereof the second from the head being the longest, was only a little above an inch, and the rest not much shorter: It is to be observed, that the red gurnard the Dr. had to compare with, was but small and something smaller than the yellow one;

in the hinder-fin of the back of the yellow gurnard, there were nine *Radii*; in the red gurnard 14; in both, the *Radii* near the tail were the longest, those in the yellow gurnard being two inches and a half long; the membrane that joined the *Radii* of the back-fins, differed very much as to colour in these fishes; for in both the back-fins of the red gurnard, this membrane was all of a white transparent colour; on the fore-fin of the yellow gurnard, the membrane was yellowish with blue spots, and some edg'd with black; and the membrane of the hinder-fin was of a faint blueish colour, with four yellow lists or streaks about a line broad, running the whole length; as in Plate XI. Fig. 1. the *Pinnæ bronchiales* (whereof there were two on each side, and their situation the same in both, the uppermost being inserted perpendicular, and the lowermost horizontal to the body) differed likewise in colour; for in the yellow gurnard the uppermost fins were white; the lowermost of a dark blackish colour, with several beautiful long spots of an azure blue; in the red gurnard the uppermost fins were of a dark reddish colour, and the lowermost white; but here, between these two fins he observed three naked cartilaginous *Radii*, which are not in the yellow gurnard, and are well expressed in *Salvianus's* figure of the red gurnard; the fin on the belly was placed exactly alike in both; here the yellow gurnard had nine *Radii*, and its membrane was of a darkish-blue colour; here the red gurnard had 17 or 18 *Radii*, and its membrane was transparent and white; the tail was much the same in both; over the *Anus* in the yellow gurnard there was a slender pendulous body, which was not observed in the red gurnard; the colour of the bodies of these two fishes likewise differ'd very much; and Dr. *Tyson* does not know, but that it may be property in this species to vary in colour, more than any other fishes do; the belly of the red gurnard and some parts of the sides near the belly, were of a silver colour; the rest, together with the back and the head, were of a reddish colour; in the head there were some small whitish spots; the belly of the yellow gurnard was white, but under the lower jaw black; the sides and back were yellowish; but between the belly and sides there ran a blue streak, or list, about a line and a half broad, from the head to the tail; and a little higher on the sides, there was a chain of blue spots the whole length of the fish; for, on the sides of the head he observed these blue spots, only, that from the eyes to the extremity of the *Rostrum*, the spots were of a deep yellow colour; there being therefore, so much blue and yellow over the greatest part of the body of this fish, the Dr. calls it

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Ceruleo flavescens; for where the ground is blue, the spots are yellow; and where yellow, the spots are blue: Tho' hitherto there seems a tolerable agreement between these two fishes, yet in the subsequent remarks, the disagreement will appear greater; for the yellow gurnard had no scales, and therefore the Dr. calls it *Levis*; the red gurnard had scales not only on the back, but likewise a ridge of spiny scales all along the sides; as also on each side of the back there were fins ranged like spiny ridges or scales; but the belly seemed almost smooth, having but few scales, and those very fine; and indeed, those on the back were much smaller than those in most other fishes; if M. *Leeuwenhoeck's* observation be true; viz. that even the anguillous kinds are scaly, then the difference will not be so great, the one having membranous scales, and the other bony ones; or it may be, that our subject is an intermediate species between the gurnard kind and some other; and this the Dr. is more apt to believe, because, tho' it has gills on each side, yet it had not those apertures at the sides of the head that the red gurnard had, and which is common to most fishes, excepting the cetaceous kinds; but like them, the yellow gurnard had two apertures, or large *Foramina*, placed on the hinder part of the head, an inch beyond the eyes, at which it spouts out the water, by blowing into these holes; he extended the cavities where the gills lay, and he observed, that over these cavities there was placed a flat bone, which, by the contraction of its muscles, might serve to force the water out; and perhaps, it is assisted in this action by another loose bone that lies over it, whose edges are jagged, or indented, as represented in the figure, at which place in the red gurnard, the Dr. observed a strong sharp spine: These *Foramina* in the head of this fish is a thing so very remarkable, that it may be looked upon as a characteristic thereof; and the Dr. does not know with what other fish to compare it; for the cetaceous kinds that have spouts in their heads, have no *Bronchie*, but lungs; and therefore, the better to distinguish this fish, he has added this particular to its name.

Dr. *Tyson* observed, that the eyes in the yellow gurnard, were placed more on the top of the head, and that the skin in this place covered almost half of them, like an eye-lid; which he did not observe in the red gurnard, whose eyes were placed more at the sides of the head; the head also of the red gurnard was more protuberant, but that of the yellow gurnard flatter; the extremity of the *Rostrum*, the teeth, and the tongue in both were exactly alike; only, that he observed in the palate of the yellow

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gurnard two cartilaginous bones, whose edges were bended downwards from the palate, and serv'd as the Dr. suppos'd, for hooking in and staying the cartilage of the tongue, when it makes a compression for forcing out the water by the *Foramina* of the head, which contrivance he did not find in the red gurnard, that fish not having the like occasion for them; the gills of this fish had four *Osseous radii* of each side.

Of Cobalt, and the Preparations of Smalt and Arsenic; by Dr. Krieg. Phil. Trans. N° 293. p. 1753.

THE *Cadmia nativa*, or Cobalt (of which is made the blue colour, call'd *Smaltum*) is a massy, heavy, grey, shining stone, found in great quantities in the mines about *Schneeberg*, and in some other places of *Misnia*; it is very often mix'd with marcasite, and sometimes with silver and copper ores; after they have pick'd out the Cobalt, and separated it from the common stone, they beat it to powder with a *Poch-werk* or stamping machine, which is commonly us'd in mines; by that operation, the water carries away the light stuff and sand, leaving the heaviest parts behind; this powder is afterwards put into a low and broad furnace, made on purpose to separate the sulphur and arsenic, where the powder is spread all over; and the fire, which is beneath and behind it, is forced to pass its flame along, and over the powder, and so carry with it the arsenic in form of a smoke, which is afterwards receiv'd by a low chimney, and out of that convey'd into a close channel made of brick-work, upwards of 50 paces, where the arsenic sticks by the way to the wall, in form of a white, or yellowish powder, which is taken out every six months, and melted into whole pieces: The Cobalt being thus roasted, and smoaking a little, is taken out when red hot, cool'd again and gather'd for melting; its colour, by that way of roasting, becomes a little more whitish.

When they have a mind to melt it, the powder of the Cobalt is mix'd with pot-ashes, and powder of white flint stones; the proportion of which is, according to the goodness of the Cobalt; or according as the Smalt is to be made of a deeper, or paler colour; for instance, they take one part of pot-ashes, two parts of Cobalt, and three or four parts of flint; this mixture is put into large strong pots, standing in a hot furnace, six or eight pots in one furnace; where it stands melting for five or six hours, when it becomes a blue glass, which is afterwards taken out with a large iron spoon, and put into a vessel full of cold water; where it cracks and becomes more tender, in order to be the more easily

easily powder'd again; but the empty pot in the furnace is fill'd up again with the aforesaid mixture; and thus they continue night and day, still maintaining the fire in the furnace: The blue glass taken out of the water is powder'd again by the common engine; the finest part being separated by a sieve, is put into a mill, and ground in water into a very fine powder, which by constant washing is separated from the coarser parts; the same is afterwards dried in little warm chambers, then put into barrels, and thus it is exported into several countries: If one of the melting pots happens to break, or to be very much burnt, so as that it must be taken out, they always find on the bottom thereof two cakes of different matter, not mix'd with each other; the undermost is a sort of *Æs Caldarium* or *Glocken Speise*, and the uppermost a marcasite: The grass and fruits growing thereabouts, where such a workhouse stands, are commonly poison'd by the arsenical smoke, so that neither cattle nor men can feed upon them with safety.

Plate XI. Fig. 2, 3, the furnace where the *Cobalt* is roasted, and the arsenic separated; *a* the furnace to roast the powder'd *Cobalt*; *b* the chimney, that receives the arsenical smoke; *c c c* the channel of stones to collect the arsenic.

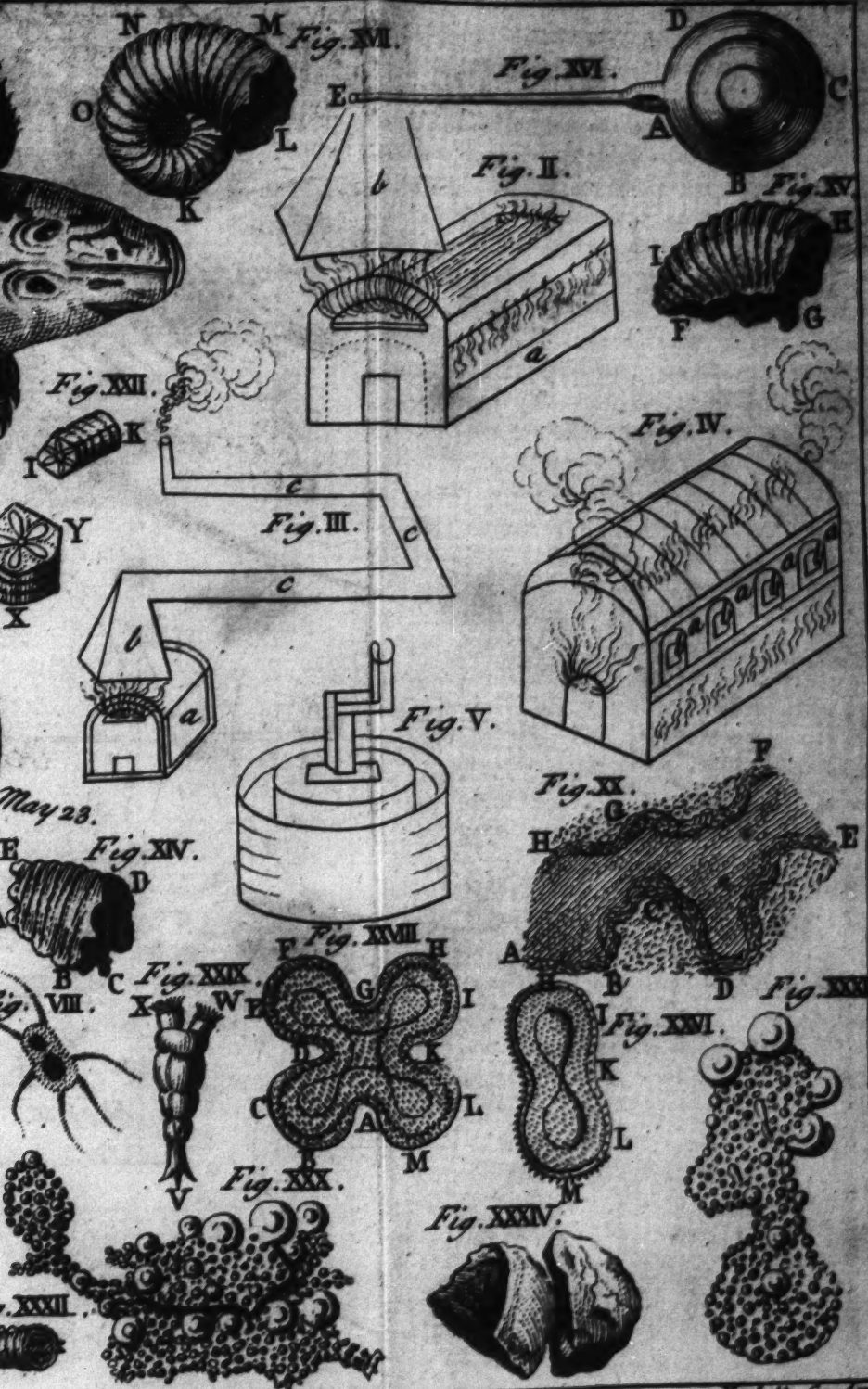
Fig. 4. The furnace for melting the *Cobalt* into a glass; *a a a* the hole where the melting pots stand; the large holes, where they put in the pots, are shut up with bricks, and a little hole as *b b b b* is left open, where they take out the glass with the iron ladle.

Fig. 5. represents two mill-stones to grind in water.

Spots observ'd in the Sun; by Captain Stannyan. Phil. Trans. N^o 294. p. 1756.

ON Saturday May the 15th, Anno 1704, as captain Stannyan, was observing the setting of the sun, in order to examine his clocks, there appear'd two suns; the mock-sun seem'd to be above the real one, which was then only five degrees above the horizon; whereupon, he took a good seven foot telescope, with a small aperture, and soon discover'd a solar spot near the sun's center, which he design'd to observe more exactly the following day, but it prov'd cloudy; on Sunday there was no sunshine; on Monday the 17th at six o'clock in the morning he took the same telescope, arm'd with a clouded eye-glass, and he immediately perceiv'd that the spot was advanced considerably towards the sun's western limb; it seem'd to be of a strong consistence, very compact, resembling a face, and it was distant, by
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May 23.

Malott's Engraving

noon, from the anterior limb of the sun's disk $61''$ of time, as represented in Plate XI. Fig. 5: On *Tuesday* the 18th at noon he found the spot distant from the preceding limb $46''$ of time; on *Wednesday* the 19th at noon he observ'd, that the spot was mov'd within $33''$ of time of his western limb: On *Thursday* at noon it was arriv'd within $21''$ of time of the preceding limb; moving nearly in a strait line, and intersecting the parallel of declination, passing thro' the sun's center; on *Friday* the 21st there was no sun-shine; on *Saturday* the 22d at seven o'clock in the morning he observ'd, that the spot was advanced very near the limb of the sun's disk; on *Sunday* the 23d at six in the evening he saw the spot, which by that time was got to the very edge of the sun's disk, resembling a barley-corn, lean and slender, and of a dulkish colour; only wanting its shortest diameter of the sun's limb; all which appearances are represented in the above figure; at eight o'clock he observ'd it again; also at 10 and at 12; at two he perceiv'd that it was got into the very circumference, and was hardly visible; had he not had an eye upon it all the day long; at four he examin'd the sun's body with a very good 18 foot telescope, but he could not perceive the least glimpse of it; so that about three in the afternoon it totally disappear'd; on *Thursday June* the 23d, about six in the evening he observ'd with his 18 foot glais four spots in the sun's disk, as in Fig. 7. which were inviron'd with a mist, thicker on the right hand than on the left, situated in the upper left hand quadrant, and distant from his nearest limb about the 12th part of the sun's diameter; from the cloud about them proceeded both ways five long curve rays, of a yellower colour than the sun's body; he could never see these spots any more, tho' he had watch'd them for several days together; on *Monday June* the 7th, at three o'clock in the afternoon, he discover'd the same spot, as he thought, that he saw go off the sun's disk on *May* the 23d, re-entering the sun's disk just at the time and place he expected it; at four o'clock, the sun being extremely clear, he mounted his 18 foot telescope, thro' which the spot appear'd distinct, but slender like a spider, with an elliptical speckly mist about it, and five or six light colour'd streaks; it appear'd to him to be divided as it were near the top, as in Fig. 8; *Tuesday June* the 8th, at six in the morning the spot was very visible, and he saw it trace again its former path, coming on exactly where he expected; it kept its shape; but those lemon-colour'd streaks disappear'd, tho' itself and the mist about it became visibly bolder and broader, as it re-enter'd the sun's disk; on *Wed-*

nesday the 9th at five o'clock in the evening he observ'd the spot with the 18 foot telescope; but he could not perceive that it had alter'd its shape; but it advanced gradually over the sun's disk, as it had done formerly; on *Thursday* the 10th, the sun shining very bright at noon, he had an opportunity of being assur'd it was the same spot; he plainly saw it move over its former path, and it was then distant from its nearest limb 29 seconds of time; at five in the evening he observ'd, with his 18 foot telescope, that its shape was alter'd, appearing bigger and blacker than ever, as in Fig. 9; *Friday June* the 11th was a bad day for observations, yet he had a sight of it with the 18 foot telescope, and it still continu'd black and bold as before; on *Saturday* the 12th, at seven o'clock in the morning, the sun's body being very clear, he saw the spot thro' the 18 foot telescope, and it retain'd its former shape; on *Sunday* the 13th, the spot was arriv'd by noon, at the same point of the sun's disk, he found it in on *Monday* the 24th of *May* at noon; which made him inclinable to believe it was the very same spot; on *Monday* the 14th of *June*, he measur'd the distance of the spot from the next limb of the sun's disk, which he found to be 45 seconds of time from the anterior edge of the sun's body; and on *Tuesday May* the 18th, it was observ'd to be in the very same place of its path, within a single second of time; at four o'clock he view'd it with his 18 foot telescope, and perceiv'd that it had alter'd its shape, as in Fig. 10; and it was distant from the preceeding limb 612 such parts, as the sun's semidiameter is 900; on *Tuesday June* the 15th at noon, the spot was 32 seconds of time distant from the leading limb of the sun's disk, and cover'd that very place, where the same spot had been observ'd on *Wednesday* the 19th of *May*; on *Wednesday* and *Thursday* there was no sun-shine; on *Friday June* the 18th at noon he observ'd the spot become very slender, but yet it was black and bold to appearance; the mistiness about it on the right hand was perceivable, and that on the left was become slender, in proportion to the spot itself, and he found it distant five seconds of time; on *Saturday* the 19th at five in the morning, it being clear weather, he saw the spot distinctly with his seven foot telescope; at nine o'clock he mounted his 18 foot telescope, observing once in each half hour all that morning; at 12 he perceiv'd, that all the cloud or misty matter, that us'd to surround the spot, was invisible; and the spot itself was reduced to little or no breadth, in comparison to what it had been towards the sun's center; and it

was so close to the limb of the disk, that he could only perceive a small streak of light between it and the limb of the sun's body; at two o'clock he could just perceive it, but it was become exceeding slender: The first revolution, he saw the spot half in the circumference of the sun's limb at two o'clock on *Sunday* the 23^d of *May*; and with the 18 foot telescope he just perceiv'd its second revolution, at half an hour after two o'clock on *Saturday* the 19th of *June*; on *Sunday June* the 27th, about six o'clock in the evening, he observ'd several spots in the sun's disk, but he had not the conveniency of using his longest telescope; on *Tuesday June* the 29th, about seven in the morning he reckon'd 16 remarkable spots in the sun's body, and near his center they appear'd thro' the 18 foot telescope, as in Fig. 11; then he took his seven foot telescope and frame, and he observ'd that the foremost cluster of six spots, that appear'd on the paper like one spot, was distant from the sun's anterior limb 81 seconds of time, and the last cluster 87, as in the said Fig. this day the foremost spot was distant from the following limb, according to the path of the spot, just 55 seconds of time; the sun's diameter was always 136 seconds in the transit, and the spot was 126; so that the path of the spot was 10 seconds shorter than the sun's diameter; on *Wednesday June* the 30th, at eight o'clock in the morning, observing the solar spots with his 18 foot telescope, he very plainly perceiv'd, that they had mightily increas'd in number, and had strangely chang'd their places; the cluster of seven spots seem'd to him to move gradually, as the single solar spot did in *May*, but the cluster of four spots went too fast forwards; the 12 spots without a mist about them straggled all manner of ways; and the nine spots, and the five black little ones went backwards, and at the same time unbent themselves as it were into a straight line, as in Fig. 12; the captain was apt to believe that this cluster went backwards, as the other went forwards too fast, or faster than ordinary; for in 24 hours, the foremost cluster advanced 21 seconds of time, which is more by six seconds than ever the single spot mov'd in that time, even when nearest the sun's center; and the distance in time between the first and the last cluster this day was greater by three seconds than the day before; the foremost cluster of four spots was distant from the advancing limb of the sun 60 seconds of time; at half an hour after four the advancing cluster pass'd the intersection in 55 seconds of time, after that the sun's foremost limb had pass'd conformably to the path of the spot; and the

last spot passed in 63 seconds of time, the last limb passing the intersection, according to the path of the spot, in 126 seconds of time, and the sun's largest diameter passing in 136 seconds; by this time the spots appear'd strangely black, and very oddly shap'd, as in the upper part of the circle in the said Fig. On *Thursday July* the 1st, at eight o'clock in the morning, he observ'd the solar spots with his 18 foot telescope, the weather being good, and he saw that they were ranged in respect of each other, as is represented in Fig. 13; the leading and largest spot being distant from the anterior limb 44 seconds of time; the last cluster, lying a little awry, pass'd in 53 seconds; after the anterior limb had done so, the following limb also pass'd the intersection, according to the path of the spot, in 125 seconds of time; on *Friday* and *Saturday* there was no sun-shine; on *Sunday July* the 4th, in the morning at eight o'clock, the leading spot was distant from the advancing limb 10 seconds of time, the spots and clusters retaining nearly the same shape, but beginning to contract themselves; the foremost he thought, look'd strong enough to perform another revolution, and it pass'd in 127 seconds; on *Monday* the 5th at seven o'clock, he found that the spots had quite alter'd their shape, appearing dull and slender, as in the lower part of the scheme, and distant about four seconds, being all included in a cloud; on *Tuesday* the sixth, at 10 o'clock viewing the sun's disk with his 18 foot telescope, he found it clear of all spots; on the 17th day of *July*, about four o'clock in the afternoon, he observ'd some spots in the sun's body, resembling those he saw on *Thursday* the 3d of *June*; only with this difference, that these appear'd to him, as if they had been heated red hot; they seem'd to be in the same part of the sun's disk; that day he observ'd them above an hour together, but he could never afterwards, nor discover, whether they were coming on or going off his visible disk; captain *Stannyan* continu'd to observe the sun, as often as was possible, with his 18 foot telescope, till the end of the month, but without farther success.

Concerning Fossils in Switzerland; by M. Leewenboeck.
Phil. Trans. N^o 294. P. 174.

M. *Leewenboeck* is of opinion that mountain crystal is not produced from ice, not that it grows in the mountains, where it has its increase, as several suppose; but, that where it is fix'd in the mountains, it is coagulated by the air, which

with

with a little moisture is shut up therein; and that the parts of crystal being separated, are again resolv'd into long particles, of which a great many are hexangular: M. Wallenius gave M. Leewenhoeck four small snail-shells which were gather'd in the mountains of Switzerland, where thro' length of time they were changed into metal, for they were very heavy; M. Leewenhoeck for his farther satisfaction, took one of the snail-shells, that he judg'd to be metal, and beat it to pieces with a little hammer; but, finding that it broke very easily, he separated the fore-part with his fingers; a small particle of which, represented by A B C D E Plate XI. Fig. 14. he placed before his microscope; B C D was what was join'd to the fore-part of the snail-shell, wherein he observ'd six prominent particles, and five others at A E, which were fitted or insinuated into the six particles; and how often soever he broke the said shell into pieces, he still observ'd in the fore-part six, and in the hinder part five particles in the same order and disposition; so that he suppos'd, it must have been a limb, or part of the inclos'd snail; and consequently, that it had been once a live animal; having placed the broken part of one of these little pieces of snail-shell, before the microscope, he observ'd that the internal matter was compos'd of very small shining particles, which a person would take to be broken pieces of metal; forasmuch, as he had seen such like seeming particles of metal, which was really nothing but brimstone; he took some of the small pieces of the shell, and putting them into a glass, and then upon the fire; he observ'd, that in proportion to the smallness of the parts, a great deal of water and sulphur was extracted from them, without discovering the least sign of metal in the remaining black matter; moreover, he examin'd that little piece of matter, which he judg'd to have been the live animal within the shell; by its uncommon weight it seem'd to have been also turn'd into metal, and the more so, when he had broken it to pieces; for then, the great number of exceeding small shining particles appear'd to be wholly metalline; the abovesaid matter was very hard, insomuch that when he struck it against a steel, it yielded sparks of fire; he broke off a piece thereof, and placing the remainder before a microscope, as shewn in F G H I Fig. 15. the more one view'd the break as represented by G H, the more one would be perswaded, that the manifold small shining particles were certainly metalline; but, when he brought it to the fire, and endeavour'd as much as he could

could to keep the smoke together, it appear'd plainly to him to be nothing but sulphur; which was manifest, not only from the smell thereof, but the extract was of a yellow colour, just as sulphur appears to the naked eye: Now, that Fig. 14. ABCDE is a part of a real snail is clear to him; but how, and after what manner the sulphur got into the shell we can only guess; M. *Leewenboeck*'s opinion of the matter is this; the snails and other things, that are found upon the mountains of *Switzerland*, and which are suppos'd to be changed into metals, have lain and do still lie, where a great quantity of sulphur is shut up in the bowels of the earth; and that sulphur, being render'd fluid by a subterraneous heat, mounts upwards in exceeding fine particles like fire, and so insinuates itself not only into the inmost parts of the snail-shell, where, according to all appearance, the snail itself is almost consum'd, but also into the pores of the shell, and is there fix'd and coagulated, so that the whole snail is converted into a sulphureous substance: This may seem strange to some; but such as are conversant in sulphur, and know into what an unspeakable great number of small parts it can be divided by fire, may easily conceive, into what a number of bodies, sulphur, being put into a fluid motion, can in the course of some ages, insinuate itself; for as M. *Leewenboeck* has been informed, these snails and other testaceous animals, which are found in the high mountains of *Switzerland*, have lain there ever since the deluge; and so, many of them by length of time become metallic bodies, or rather as M. *Leewenboeck* supposes, mostly sulphureous; now, in order to shew the exceeding small particles into which sulphur is divided, by fire, he prepared a little glass globe, represented by A BCD, Fig. 16. and therein at B he placed a small particle of sulphur about the bigness of a single grain of sand; and when the glass, and the included air was so temperate as the air we commonly breathe in, he sealed hermetically that part of the glass which was open at E; and then blowing the flame of a candle upon the other part of the glass, where the sulphur lay, till it evaporated into smoke, which for a small space of time was carried about the glass in a circular motion, and after that the sulphureous smoke had subsided, and settled itself on the glass, he examined it with a microscope, and observed so many exceeding fine particles on the sides of the glass, that no person could believe, that such a small grain of sulphur could possibly be divided into so many parts; insomuch, that the smallest globules of this divided sulphur could hardly be observed with one of his best

best glasses; and the largest globules lay round about the sulphureous matter, that was not quite dissolved: He let the glass-globe lie still about half an hour, and then viewing it anew, he was surprized to find, that some of the small globules of sulphur that lay a little remote from the rest, had formed themselves into a right-line, and that four or five were placed lengthwise; and that some globules were so extended in length, that they touched each other; but some hours after, they were all united, and composed one small body just like saltpetre, when joined to water it begins to coagulate; these inclinations or coagulations were the more surprizing, because some of them were twice, others thrice as long, as some others that lay thereabouts; and just by these coagulated long particles there lay other sulphureous ones, but none very small: It is true, that in the fluid substances we daily see, homogeneous particles do, thro' a secret inclination, coagulate together; but how the particles of sulphur, that are glewed down as it were, to the glass, should assemble and unite into one body is very surprizing.

M. *Leeuwenhoek* had a snail-shell, as represented by K L M N O. Fig. 17. which was very heavy in proportion to its bigness, and seemed to him not to be quite whole, but that some part was broken off at L M; upon breaking it to pieces, it seemed to be full (excepting the slenderest part of the tail) of a pale yellowish substance, that was visible enough to the naked eye: M. *Leeuwenhoek* to satisfy himself, about the said apparent metal-line particles, put about a fourth part of the last-mentioned snail-shell into a glass, and brought it to such a strong fire, that the glass was just ready to melt; in this operation, he separated a great deal of sulphur from it; and when he took the remaining matter out of the glass, he observed that all the sulphur was not quite extracted; for he discovered several sulphureous particles lying in the remaining matter, which one would take for a black burnt earth; and they were divided from each other in oblong particles, each having distinct figures, according to the places they were to possess; he sealed up hermetically the glass, wherein the extracted sulphur was coagulated, to the end that no moisture or vapours might either get in, or escape out of it; and then viewing those sulphureous particles, that had lain farthest from the fire, he saw, (tho' nothing thereof was perceptible to the naked eye) that the glass was covered with globules, just as if one had spread a table all over with sand; and when he viewed the same a little while after, he saw that the small particles were coagulated together into irregular figures; and as he imagined before

before, that the small sulphureous particles were fastened to the glass; now he saw an oleaginous, and watry substance, which might be called the spirit of sulphur, drawn off together with the sulphur; and that several places in the glass had no globule, and nothing to be seen but this oleaginous matter. He had also a third snail-shell, whose outermost part or shell, was as smooth as if it had been polished; and when he view'd it thro' a microscope, he observed that it was adorn'd with surprising figures, from which he concluded, that the lustre or smoothness of the shell was occasioned by a long and frequent attrition thereof against other hard bodies; as it is to be seen in stones that are found on the sea-shore, which, by the frequent motion of the waves or sand about them, become very smooth and polished; and it was by such motions, that the fine figures in the shells are quite worn out; this shell described by Fig. 18. PQR, he could break very easily with his fingers, and discover with his naked eye, that it was for the most part compos'd of the above-mentioned shining matter, as also full of sulphur. He had also another snail-shell, represented by TVW. Fig. 19. which was also very smooth; and upon breaking that shell to pieces, what seem'd to be so smooth to the naked eye, did now appear with as many scratches, as if it had been rubb'd with sharp sand; and this was likewise adorn'd with figures, that were not discernable by the naked eye; a small part of which is represented by ABCDEFGH. Fig. 20. which was rais'd a little above the other part of the shell, and some part was lower as BCD.

The above-mentioned M. *Falkenh* gave him a little body, whose shape is represented by XYZ. Fig. 21. which is also found in the mountains of *Switzerland*; and it seeming to the naked eye to consist of three joints, he endeavour'd to separate them from each other, in order to discover, if possible, its internal figure; and tho' he attempted to divide it in the jointed parts with a sharp steel, yet he could not compass it, but broke it into irregular pieces, all which were so smooth and shining within, that the like never occur'd to him in any common stone; and moreover, it was more than ordinary hard; the best judgment M. *Leewenboeck* could form of it was, that it consist'd of star parts; he laid the biggest piece thereof upon wood-coal, and brought it gradually into a strong glowing heat; in doing of which, at first some splinters flew away; and he could not perceive, that there was any sulphur in it; whereupon, he dropp'd it into a small copper-vessel, wherein was a very little water, to see, whether that would separate the parts, in order the better to dis-

discover the homogeneous particles; but, instead of doing so, it divided into a vast number of unspeakably small white particles, which may be call'd a chalky substance; as soon as this chalky matter was separated, he observ'd a film or scum upon the water, which he suppos'd to be the coagulated salts thereof; he took a little of the said water from under the scum, and pour'd it upon a clean glass, and viewing it presently after, he discover'd to his great surprise, such a vast number of clear and transparent salt particles (several of which were so fine and slender, that they seem'd to have but one circumference) and of such various and different figures, that there was no tracing them; and they were so very small, that several thousands of them together could not equal the magnitude of a single grain of sand; and forasmuch, as a great many of them were long, he imagin'd that that figure might be peculiar to them; and that all the rest had only assum'd a borrow'd form, which might be determin'd, by the different manner of their uniting or coagulating in several places; he let the water stand a few days upon the chalky substance, till it was all evaporated, and then he discover'd a great number of very small shining particles, lying at the bottom of the above copper-veffel; all which he took out as clear as he could, and placed them on three several clean glasses, and then viewing them with a microscope, his surprise was still greater; for he observ'd, not only different figures, but that no two of them were alike; but all of them were as clear and transparent as crystal; yea, some of them had as fine and regular points as a wrought diamond, tho' above a thousand times smaller than a coarse grain of sand; amongst others, there appear'd to him such a triple-jointed body, as is represented by X Y Z Fig. 21. which he also endeavour'd to separate by its joints, but in vain; he also laid this upon wood-coals to make it glowing hot, as he had done the other, but a good part thereof flew away, when it was but just warm; and as it began to be hotter, it flew so about, that had he proceeded farther, he could have sav'd none of it; whereupon, he took a glass-tube above a hand's breadth in length, and hermetically seal'd at one extremity, into which he put what remain'd of the abovementioned figure; and then heating that extremity of the tube, the said matter burst with great violence into such small particles, that several of them seem'd as fine as meal or flour; and if he had not stopp'd the open extremity of the tube with his finger, most of this dissolv'd matter would have forced its way out; afterwards, he put the said tube into a glowing heat,

when he observ'd, that a great deal of thin watry vapours were extracted from the rest of the aforesaid substance; and upon viewing the small particles that were on the inside of the glass, he saw a great many very thin scales, some of which had right angles; and all of them seem'd to be compos'd of such small particles, as fine sand appears to be to the naked eye; he took the aforesaid matter out of the glass-tube, and placed it upon a wood-coal, in order to put it into a greater heat; but, as soon as he had put it on the fire, the small particles flew away so fast, that he was obliged to put it into the tube again; and after having made it red hot, he pour'd it out of the tube into the water; but the heat was not so great as to make it turn into a chalky substance, excepting a little piece, no bigger than a pin's head, which he heated again without flying or breaking, and dropping it into the water, it dissolv'd into a chalky substance; he had several such like particles, but much smaller, consisting of five joints or ribs, which are also found upon the mountains of *Switzerland*; he slit this particle, represented by I.K. Fig. 22. thro' the joints, but he could not do it so nicely, but that a small piece of another joint stuck to the largest; whereby, he could not so perfectly discover the rose like figure, as represented by I; he also laid these slit particles upon wood-coals, intending to heat them leisurely; but they flew about so, that had he proceeded, there would have been none left upon the coals; wherefore, he also put them into a glass-tube, as before, but without any other success, tho' he held the tube and the aforesaid matter in it; first in the flame of a candle, that it might be leisurely heated; and by this means it was dissolv'd in such a manner, that it seem'd to be nothing but a powder; and in this operation there was some moisture exhal'd; from this surprising bursting, and that into such small pieces, he concluded, that a great many watry particles were shut up in this matter; and that these particles were so strongly united, and were, moreover, of so tenacious a substance, as did not admit of the least evaporation of moisture; and that these watry particles, being rarified by heat, requir'd a larger space, and so occasion'd the bursting of the said matter; he set the said tube with the powder in it over so violent a heat that it was ready to melt; and immediately after, he pour'd the powder into water, but it did not become a chalky substance; and afterwards, decanting the water into a clean glass-tube, he observ'd, that it was impregnated with salt particles; in this operation he saw upon the sides of the glass a great number of ex-
ceeding

ceeding thin particles like I K Fig. 22. and such as were the thinnest now appear'd just as the small pits on the outside of a thimble do to the naked eye.

Fig. 23. NO represents one of the small splinters that burst in the fire, as it appear'd before a microscope; this splinter was so narrow, that it had but three rows of little pits or holes, which were all three no broader than a hair of the head; and the holes in some other splinters were still smaller: From these discoveries, M. *Leewenboeck* was led to consider, whether there had not been some matter shut up in each of these holes, which being rarified by the heat, possess'd a larger space; but all being close shut up, and having no passage thro' the pores, occasion'd those bodies, represented by I K Fig. 22. to burst into so many thousand pieces.

M. *Valkenier* gave M. *Leewenboeck* two little dice, as represented by L M Fig. 24. adding, that some people said they were stone, others bone; and that they were found deep under ground in *Switzerland*, and in great numbers, in a place where there had been formerly a *Roman* camp; and that the *Swiss* were of opinion, that the *Roman* soldiers, whilst they were encamped there, made use of them in play; M. *Leewenboeck* struck several blows with a hammer on one of these dice, which indeed made holes in it, but without breaking it; whereas, had it been stone, it could not have withstood so many blows; at last, cutting off some small bits, and making them glowing hot in the fire, he observ'd, that it was black, as bone is, when it has not lain long therein, and white when it has lain longer; in his last viewing of it, he was still the more confirm'd that it was bone, for he could then discover the pores of a bone; yet, he supposes that it could not be an ox-bone, because the pores were smaller.

Experiments about the Motion of Pendulums in Vacuo; by Mr. Derham. Phil. Trans. N° 294. p. 178.

MR. *Hawksbee* made an experiment to discover the difference between the vibrations of *Pendulums in Vacuo*, and in air; the movements he tried with, were an eight day clock vibrating seconds, and another half second movement of Mr. *Derham's*; the *Pendulum* of this latter vibrated $\frac{1}{2}$ of an inch on each side farther in *Vacuo*, than it did in the free air; and went seven seconds slower in 20 minutes, than the other; but in the open air it went in 20 minutes, only three seconds and a half slower than the other *Pendulum*.

Mr. *Derham* himself tried this experiment with the following instruments; as an air-pump of Mr. *Hare's*; the aforesaid small movement, with a *Pendulum* of about 10 inches, vibrating half seconds, and driven by the power of a spring; this instrument was commodious, not only for being easily fitted with a receiver, but also for vibrating half-seconds very nicely; and also because its vibrations were equal; the last instrument was a very well regulated month-piece, vibrating seconds, with tolerable exactness: The result of several repeated experiments was, that the vibrations *in Vacuo*, as before were always larger, than in the unexhausted receiver; at first, after Mr. *Derham's* little movement was newly clean'd, the vibrations were above $\frac{1}{10}$ of an inch larger than in the free air; but afterwards (he supposes from some of the foul'd oil of the pump sparkled on the wheels, in letting in the air, whereby the force of the spring on the pallets was weaken'd) as the vibrations in the unexhausted receiver were a little contracted, so in the exhausted receiver they were more contracted, and only about $\frac{1}{25}$ of an inch larger than in the free air: The alteration in time, which this difference of the vibrations produced, was constant, only about two seconds in an hour slower in the exhausted, than in the unexhausted receiver; for, if in four, five, or more hours going, the two *Pendulums* did not vary $\frac{1}{2}$ of a second in the open air, or when the unexhausted receiver was put over the little movement; yet when exhausted, the half-second movement would in several hours going, lose in every experiment at the rate of two seconds in every hour; in order to observe what alterations would arise from varying the vibrations; he therefore, by opening and shutting the pallets, caus'd the vibrations in some experiments to be as large as the receiver would bear; in others, to be as short as possible, always adjusting the *Pendulum* to vibrate half-seconds nicely in the air; but still the success was much the same, or the difference was scarcely perceptible; only Mr. *Derham* imagin'd, that when the *Pendulum* vibrated but a little way from the perpendicular, the vibrations *in Vacuo* were not so much enlarged, as when it vibrated in a larger arch: In all these experiments, repeated divers times with the same success, he had reason to think that the vibrations were enlarged *in Vacuo* by the vast rarefaction of the medium, only, that perhaps the different state of the air might alter the force of the spring, which drove the movement; to be satisfied about this, he put a well adjusted pocket watch (with Dr. *Hook's* Regulation, i. e. the common small spiral spring to the ballance) *in Vacuo*; and after several trials, at the same pitch of the spring, he

he did not find the least alteration in the watch's going in several hours; neither the springs, nor any other part of the watch seeming to be in the least affected by the *Vacuum*, the ballance circumvolving, or keeping the same turns, as in the open air; but to be still more certain, he tried what the success would be by putting the half second *Pendulum* into the receiver again, and only exhausting a part of the air; and accordingly, he left no more air than what kept the included mercurial gauge at about six inches high; the event of which was, that the vibrations were then not above $\frac{1}{10}$ of an inch larger on each side, than in the receiver unexhausted; and the time lost was, but about $\frac{1}{4}$ a second in an hour, or $\frac{1}{2}$ at most; and so, according as the mercurial gauge was more or less high, he always found the vibrations larger or smaller, they gradually decreasing, according to the quantity of air re-admitted.

From these experiments Mr. *Derham* makes the following remarks. 1. That what Mr. *Boyle* long since observed (from a cock'd pistol going down as fiercely in his *Vacuum*, as in the air) may be hereby farther confirm'd, viz. that the air is not the cause of the motion of restitution in solid bodies, as springs; for if it was, it would certainly have been discover'd in so tender an instrument, as a well adjusted pocket watch, lying under the constant influence of two springs. 2. As in *Vacuo* (where the pressure of the atmosphere is taken off) heavy bodies descend quicker than they do in the open air; so it may be observ'd, that *Pendulums* move swifter in the exhausted, than in the unexhausted receiver; that heavy bodies descend quicker in *Vacuo*, is evident from the swift descent of the lest heavy bodies; as cork, the down of sow-thistles, the lightest feathers, &c. which do all descend precipitantly, like a stone, in a tall exhausted receiver; and that the *Pendulum*, in the above experiment, mov'd faster in *Vacuo*, is manifest from its vibrating but two seconds in an hour slower, when the vibrations were $\frac{1}{2}$ of an inch on each side, enlarged by the highest rarefaction of the air; whereas Mr. *Derham* found by experiment, that nearly the same increase of the vibrations, makes the *Pendulum* in the open air go six or more seconds slower in an hour; he says, nearly the same increase, because it is scarcely possible to manage the pallets so nicely, as to make the same vibrations as were in *Vacuo*. 3. Mr. *Derham* queries, whether the variations of *Pendulums*, observed under the *Equinoctial*, and between the *Tropics*, do not arise as much, or more from the rarity of the *Medium*, and the increase of the vibrations consequent thereupon? It is scarcely to be doubted, he thinks,

thinks, that the air is much thinner, and finer near the *Line*, than it is without the *Tropics*; and it is evident from the barometer, that, on the tops of high mountains, the atmosphere gravitates less than nearer the center; and therefore (tho' he approves of the notion of the decrease of gravity from the increase of the distance from the center of the earth, yet) he is apt to think, that this is not the only reason of the phenomenon; therefore, he wishes that Captain *Halley*, when he observed, that his clocks went slower at *St. Helena*, than in *England*, had at the same time observed, whether the vibrations were not enlarged: It would therefore, be worth the while for such as have an opportunity, to take notice, whether their *Pendulums* between the *Tropics* do not make larger arches, than in higher latitudes? As also, in what latitude they begin to alter? Whether the vibrations be greater near the *Line*, than in any other part between the *Tropics*? Or, whether the greatest increase be not always in those places, where the sun passes their *Zenith*? If the vibrations be found larger under the *Line*, or in any other part of the *Torrid Zone*; then it may be observed, how much larger they are, and in what proportion they increase or decrease, by approaching nearer to, or receding from the place of their greatest increase? Also, it may be worth observing, whether *Pendulums* do not vary on the tops of high places, or in different states of the atmosphere, according as the mercury is high or low in the barometer? But then in this, and indeed, in the former cases, it is necessary, or at least very expedient, that the movement be so exactly well made, that the power, whether weight or spring, do at all times exert the very same force upon the pads or pallets, which is very rarely met with; for, most clocks are apt to vibrate sometimes larger, sometimes smaller arches in 24 hours, according as the weight or spring, does more or less exert its force on the work.

Animalcula on the Roots of Duck-weed; by M. Leewenhoeck.
Phil. Trans. N° 295. p. 1784.

IN the month of *July* *M. Leewenhoeck* caused several of these weeds, as they were carried by the stream thro' *Delft*, to be taken out of the water in an earthen pot; and taking several times a full view of the *Animalcula* that were fastened to the small roots of that green stuff, they appeared as represented by ABCDEFG. Plate XI. Fig. 25. A B G shews the case or sheath, into which the *Animalculum* betakes itself, upon the least shaking or stirring of the duck-weed, and then thrusts itself out again as far as B C F G, when at the same time appear the two little wheels represented

presented by CDEF; in observing the motion of which, a person would be apt to take them for two real revolving wheels; but as soon as he could place the *Animalculum* before his eyes, in such a position as to view the little wheels, not partially, as here represented, but completely, and all at once, he was convinced of his mistake in his former assertions; for now he plainly saw, that what appeared before to be two distinct little wheels, was really one and the same circumvolution.

Fig. 26. HIKLM represents the said wheels, larger than they appeared to the sight, wherein the rotation proceeds from H to I, and so on from I to K, and from K to LM: M. *Leewenhoeck* was at last fully satisfied about this surprising and regular phenomenon; forasmuch, as having thrown away those weeds (to the roots of which the aforesaid *Animalcula* adhered) and made his observations on several others, he found the same appearance every time, only with this difference, that the internal arches, represented by K and M, in the said Fig. were not near so much indented. During these observations, one *Animalculum* appeared as represented by NOPQRST Fig. 27; N that part of it, by which it was fastened to the weed; this *Animalculum* had its receptacle, or little house, represented by NOT, composed of round bubbles, which figure had not occurred to him before; when this *Animalculum* had thrust that part of its body from O to P out of its case or shell, it extruded at the same time that surprising wheel-work that consisted of four round parts represented by PQRS in the said Fig. three of which were to be seen very plain, but the fourth at T was almost hid from the sight; this wheel-work moved from P to Q, and from R to S.

Fig. 28. ABCDEFGHIKLM represents that instrument, that in Fig. 27. is for the most delineated by PQRS, and is shewn with a larger circumference than it really appeared to the sight, wherein was to be seen the said teeth and wheel-work move from ABC to D, and from D to EFG, and in that manner perform its whole revolution; at the least sudden touch of the *Animalculum*, it presently drew the wheel-work into its body, and then its whole body into its case or shell, so that nothing could be seen but a kind of horn, as NOT. Fig. 27. wherein it hid itself; but it quickly thrust forth that part of its body represented by OPQRST, and then the rotation proceeded as before: Now if any should be inclined to make this experiment, he must take care to chuse out duck-weeds that have long roots; for, M. *Leewenhoeck* never observed any of these *Animalcula* in the short

short roots of young weeds; nor indeed, in the large roots, when once they are covered with a rough matter, and tend to decay, as he has seen a great many in the beginning of *August*; and he has examined more than 2; roots, without meeting with any of these *Animalcula* thereon; as also, on the contrary, he has sometimes found three of them upon one weed: Moreover, in one of his glasses, where Mr. *Loewenboeck* had shut up a weed with its root, there was an *Animalculum* the third part of an inch long, and something thicker than the small root of the duck-weed; the body of which was for the most part transparent, only, there was a gut, or intestine, that ran thro' the whole length of the body, and was wrinkled, or shrivell'd up in several places; and as it came towards the head, it became rounder and thicker, which he supposed to be the maw or stomach; this gut was full of aliment throughout, which the *Animalculum* had gathered either from the roots, or the excrescent particles round about; and forasmuch, as the upper part of the head was provided with a long and pointed horny substance, like a sturgeon; so likewise was the mouth inwards, and joined to the extremity of the belly; the said gut being filled with aliment, was in a continual motion, which he calls a pinching or twitching, in order to the attenuation or protrusion of the chyle; and had not the guts been thus full of aliment, which hindered its transparency, he would have seen all the *Vertebrae* of the back-bone; the third day, after he had shut up the *Animalculum* in his glass, he saw a long and slender little worm, which he judged to be a thousand times smaller than the aforesaid *Animalculum*, which had insinuated part of itself into the body of the *Animalculum*; and as far as it appeared to him, the worm laboured to get all its body in; and next morning he discovered, that it had in a manner got quite in; and at night he could see nothing of it but a little bit sticking out; and then he could see, that in the place where the worm had insinuated itself, the *Animalculum* was partly without any aliment, or motion; whereas, there still continued some motion above and below that place; upon the fifth day after, he saw another worm attempting to get into the body of the *Animalculum*; upon which it made a great stir with its body, and so shook off its enemy; and presently after he saw no motion in the guts; so that he concluded, that the death of the *Animalculum* was approaching; after which it abandoned the root of the duck-weed, and placed itself on the side of the glass, and in a little while after, he saw it lie dead at the bottom; from hence he firmly concluded, that the death of the *Animalculum* was occasioned by the worm's piercing into its body,

body, whereby the guts were wounded in such a manner, as to be deprived of all motion; among several sorts of small *Animalcula*, he observed three, whose bodies were about as thick as a hair of the head, and 10 times as long; these *Animalcula* were so transparent, that at first he took them for empty skins; for he could see nothing but an exceeding small part thereof about the head, and the hinder part of the body, which was not transparent; and what he judged to be the bowels, was a small part of it inclining to a yellowish colour; and they had on the fore-part of the head, as it were, two very crooked claws, and on the hinder-part of the body several transparent hairs; he observed these *Animalcula* several days together, and he always saw, that they moved their bodies very nimbly in a serpentine motion, and as it were in an instant of time, and so moved about from place to place; and as often as he viewed them, he could never find, that they sat still on the roots of the duck-weed, or on the sides of the glass, but were continually roving about in the water; afterwards, when he viewed them again, he could not perceive the least motion, either internal or external, in their bodies; but he observed, that sometimes they subsided in the water, and then emerged again, but very leisurely; which appeared surprising to him; because, as he said just now, he could not discover the least motion in their bodies; tho' he does not doubt, but that there is some motion, be it never so small, in a body, which in the space of two or three pulsations, shall one time sink to the bottom, and then emerge to the top; for it is impossible to set an inanimate body in water in such a position, that it shall neither sink quite down, nor emerge quite up to the surface; and tho' we could find a body (which M. *Leeuwenhoeck* thinks is not to be done) that should be precisely of the same weight with the water, yet it would not keep the place in the water which was first assigned it; for, according as the water, into which you put that body, would decrease or diminish in heat, that same water would proportionably take up more or less space; and consequently, the body that was placed, so as that it could neither entirely emerge nor subside if the water, for instance, should become warmer and so take up more room, would immediately sink to the bottom: The only solution, therefore, that M. *Leeuwenhoeck* can give in this case, is that such an *Animalculum* has some air in its body; and that by squeezing and contracting itself, it can emit some of the *Materia subtilis* mixed therewith, by which it naturally subsides; and *e contra*, by dilating its body again, an equal quantity of the same *Materia subtilis* is let in; and thus

the *Animalculum*, without stirring itself, will either rise or sink.

M. Leewenhoek was the more easily induced to assert what he formerly did about the *Animalcula* fastened to the roots of duck-weed, their having two distinct revolving wheels; because he had discovered several *Animalcula* that protruded two wheels out of the fore-part of their bodies, as they swim, or go upon the sides of the glass; one of which is represented by V W X, Fig. 29; in summer he found this sort of *Animalcula* in great numbers in the gutter-water, which had stagnated for some days in the small pits or cavities of the lead; these *Animalcula* are gradually less and less, so far that 50 small ones are not so large as a full grown *Animalculum*, big with young; in the month of October, 1702, he caused the dirt of the gutters, when quite dry to be gathered together, and taking a small quantity thereof, he put it into a paper upon his desk; upon a little of which he had often poured boiled water, after it had stood till it was cold, to the end he might obviate any objection that should be made, as if there were living creatures in that water; for these *Animalcula*, when the water runs off or drives away, contract their bodies into a globular or oval figure; after that the above-mentioned dry substance had lain near 21 months in the paper, he put the remainder of what he had by him into a glass-tube of an inch diameter, and poured thereon boiled rain-water, after it was almost cold; and immediately viewing the smallest parts, particularly, that which subsided leisurely to the bottom, he observed a great many round particles, most of which were reddish, and they were certainly *Animalcula*; and some hours after, he discovered a few that had opened, or unfolded their bodies, swimming thro' the water, and a great many others that had not unfolded themselves were sunk to the bottom, some of which had little holes in their bodies; from whence he concluded, that the little creature called the mite had been in the paper, and prey'd upon the aforesaid *Animalcula*; next day he saw three particular *Animalcula* swimming thro' the water, the smallest of which was a hundred times more minute than the aforesaid ones; so that it is surprising, that these small insects can lie 21 months dry, and yet live; and as soon as they are put into water fall a swimming, or fastening the hinder parts of their bodies to the glass, and then protrude their wheels, as represented in the Figure; in the month of September he put a great many of the last-mentioned *Animalcula*, into a wide glass-tube, which presently placed themselves on the sides thereof; whereupon pouring off the water, he then observed that
 Several

several *Animalcula* to the number of 18 or 19, lay by each other in the space of a coarse grain of sand; all which when there remained no more water, closed themselves up in a globular figure; some of the bodies of these *Animalcula* were so strongly dried up, that one could see the wrinkles in them, and they were of a reddish colour; a few others were so transparent, as if they had been little glass balls, that if you held them up between your eye and the light, you might move your fingers behind them, and see the motion thro' their bodies; after that these *Animalcula* had lain thus dried up for a day or two, in an oval or globular form, he poured some water into the glass tube, whereupon they presently sunk to the bottom; and after the space of about half an hour they began to open and extend their bodies, and getting clear of the glass, to swim about the water; excepting only two of the largest that stayed longer on the sides of the glass, before they stretched out their bodies, and swam away; after M. *Leeuwenhoeck* had poured the water from them, in order to see, how they brought their bodies into the above-mentioned orbicular form, viewing two of the largest of these *Animalcula* with a microscope, he observed, that in the space of a minute they stretch'd out their bodies several times to an extraordinary length, and thrice opened the hinder part of their bodies, and voided their *Faeces*; which in the little water that remained about them, were dissolved into small pellets, before they assumed their round figure.

Before the dirt and filth of the leaden-gutter was quite dried up, he took a handful thereof, and laid it on a glazed earthen dish, in order to preserve it; this foul stuff when dry is as hard as clay; so that the mites cannot come at the *Animalcula* that are thus doubly shut up; upwards of 21 months after, he took some of this dry stuff, and infused it both in cold water that had been boiled, and in rain-water newly fallen; whereupon the *Animalcula* began to show themselves, and that in great numbers; and soon after there appeared two sorts of much smaller ones.

Several persons conversant in tillage and grazing assur'd M. *Leeuwenhoeck*, that they had never known such a plentiful year for grass, as also for pease and beans, as was the summer ensuing, the great storm in November 1703 (which M. *Leeuwenhoeck* ascribes to the sea-water being carried by the storm over the meadows and orchards) and particularly, one that fattened Danish oxen, told M. *Leeuwenhoeck*, that he had a piece of ground, on which he fed 26 oxen; and that if, he had turned 26 more into the same pasture, there would have been grass enough for them; and that

he had never seen so much grass before; and the oxen were all exceeding fat.

Observations on staining the Fingers, with a Solution of Silver in Aqua Fortis; by the Same. Phil. Transl. N° 295, p. 1794.

M. *Leeuwenhoeck* took 24 ounces of mix'd metal, and putting the same into *Aqua fortis*, he set it on a sand heat; and there being a defect in the glass, it crack'd; by which means some of the *Aqua fortis*, which was impregnated with silver, run into the sand, and he does not know, but he might also have lost gold therein; he got together as much of this sand as was wet; and tho' he took all imaginable care, that the wet sand should not stick to his fingers, yet he saw that the tips of them were stained, so that with his naked eye he could see a discolouring of the skin; and as this happened in the evening, he washed his hands in common water, and next day he saw, that the tips of most of his fingers were black; he then took some fresh butter, to get the blackness off his hands and fingers, but how hard soever he rubbed them with the said butter, it had no manner of effect; he afterwards took some soap, but all in vain; he rubb'd his thumb on a grind-stone with water and sand, which lessened the blackness a little, but did not take it quite off; the third day looking very attentively upon his black fingers, he resolved to cut off some thin scales of the skin, no bigger than a fourth part of his nail, to see if he could get any silver out of it, that was perceptible; he laid these pieces on charcoal, such as is used by the gold and silver-smiths, and blowing very gently with a pipe, the flame of a candle upon the said small particles of skin, which frying in the flame, a great many bubbles of air arose in them; and at last, driving more fire thereon, the skins were burnt, and the particles of silver, with which they were impregnated, remained, being melted into round globules, insomuch that he judged that 1000 of the smallest could not form one large globule; and narrowly viewing some of the largest, he could see that they consisted of a great number of small globules, which the fire was not strong enough to dissolve into a perfect roundness; these abovesaid silver globules were not so large as to be seen with the naked eye; he repeated this operation the fourth day, after his hands had been so stained, and that with the same success.

Plate XI. Fig. 30. A B C D E F G H I, represents the abovesaid silver globules, as they appeared thro' the microscope, and

as they were joined to each other in melting; from whence it appears, that the fire was not hot enough to form them all into one globule, and they were no bigger than a coarse grain of sand.

Fig. 31. KLMNOPQ also represents some silver globules, which were melted in the fire, in the same form; and which also came out of a small piece of skin, no bigger than the fourth part of his nail; that round part marked KLM, was also surrounded with a great many small bubbles, that were all melted, but not so completely as to be joined in one.

M. *Leeuwenhoek's* middle finger, had a sort of swelling that smarted when he squeezed it, at that place against which the pen leaned when he wrote; therefore, cutting off the swelling, and viewing it with a microscope, he found that there was a small roundness in the place, which he loosened as much as he could with a sharp needle, and laying hold of it with a pair of tweezers, he pulled a long particle out of the skin, about the thickness of a slender pin, and about 10 times as long as its diameter; it terminated in a point, and had at the root some small vessels or veins, out of which he perceived, that it received its nourishment; into the cavity of the skin, whence the said thorn-like particle was extracted, he thrust a little bit of *Roman vitriol*, and then he dropped a little water on the vitriol, that it might dissolve, and kill the roots from whence this thorn-like particle sprung; and tho' he repeated this several times, yet it grew in a few days again; hereupon he took some *Aqua fortis*, and letting a small drop thereof fall into the cavity of the skin, it was no sooner there, than it seemed as if it boiled, which was occasion'd by the air bubbles that endeavoured to force their way out; as soon as the *Aqua fortis* had penetrated to the sensible part of the skin, it smarted a little, whereupon, he poured some common water on the place to weaken the *Aqua fortis*; but quickly after the thorn-like particle increased as before; he took *Aqua fortis* a second time, and let it lie so long on the skin, that it smarted more than it did before; and since that time he did not perceive that particle to grow any more.

M. *Leeuwenhoek* had a linen-handkerchief stained by *Aqua fortis*, impregnated with silver, with a black spot about the bigness of a shilling; after that this handkerchief had been washed 6 times, and laid to bleach, he cut out the black spot, and burnt it upon a bit of charcoal, and viewing thro' a microscope what remained, he found that it consisted of several 1000 globules of silver, of an exceeding smallness.

Hydatides voided by Stool; by Dr. William Musgrave. Phil. Trans. N^o 295. p. 1797.

IN April 1704 Dr. Musgrave was call'd to see one Mrs. Pear of Tiverion-town; she was about 30 years of age, of a tender constitution, had a bad habit of body, and a fever the preceeding *Candlemass*, which continuing near three weeks, was at length overcome by testaceous powders, alexipharmics, but chiefly by the *Cortex*; in this fever she had four vomitings, and a pain in her stomach, which continu'd a long time; and after the fever, it was accompanied with a plentiful salivation, together with *Flatus*'s and pains in her side, to an extraordinary degree, under all which the patient labour'd to the time of the Dr's seeing her; about three weeks before his visit, she was seiz'd with a jaundice, and whilst she was taking medicines; viz. *Pilule & Decoctum ictericum Fulleri*, for that illness, she discharged several bladders by stool, and continu'd so to do, sometimes every day, at other times once in two or three days, ever since the first discharge of this kind, to the time of the Dr's visit; these bladders were of various sizes; the least that came off, was about the bigness of a large pin's head; the largest was equal to a pullet's egg; they were also of different colours; some were white, others more yellow, from the liquor contain'd in them, which was a sort of jelly, like that of hart's horn, tinged more or less with saffron; before the discharge of these bladders, there was, besides the symptoms already mention'd, a coldness and sickness at her stomach, which was almost perpetual, with frequent inclinations to vomit, and hysteric suffocations; since that discharge, these symptoms disappear'd, and were succeeded by a soreness of the same part, as if something had been torn there; the bladders were discharged without pain; several of them whole and entire, one of which the Dr. saw, that was about the bigness of a large gall, or marble stone; others were broken, and appear'd not unlike the empty skins of currants, gooseberries and plumbs; one bladder only, and that a broken one, came away by vomiting; but to all appearance, it had been almost as large as a goose-egg; the jelly thrown up with this bladder, and which in all likelihood, had been contain'd therein, before it broke in coming up, was thicker and more foetid, than what was found in any of the other bladders; the number of those discharg'd by stool was very considerable; during the whole course of this illness, the patient was rather loose than costive; had no manner of appetite, and seldom slept without an opiate; the Dr. found her much wasted in flesh.

flesh, with a dead pale look, such as argued her being very low; she had stools of an unusual stench, and no ways natural; and she vomited a great deal of cold phlegm.

The patient believ'd, that these bladders proceeded from her stomach, and she urged the following reasons for her opinion: For, 1. Had these bladders been originally in her bowels, in all likelihood the purges (of which she took several in the jaundice) would, as she said have carried them off much sooner. 2. From the almost constant pain of her stomach, and frequent inclination to vomit, ever since her fever, to the time of discharging the bladders. 3. From the rawness and sourness of her stomach, after the bladders were discharged. The Dr. thinks, that these reasons may be esteem'd to have force so far, as to prove that some, and perhaps a great number of these bladders proceeded from her stomach: There was no appearance in any one of these bladders, of such an order of parts, or organs, as might shew them to be insects; nor upon examination, was there any animal discern'd by the naked eye, in the liquor contain'd therein: The medicines administred, after the Dr. was call'd in, were chiefly of the vulnerary, and digestive kinds; that which did her most service (but it was after the bladders were discharg'd) was the tincture of myrrh and gentian in large, and repeated doses, in the proper vehicle; by the use of this medicine, from a very weak condition, she recover'd her appetite, &c. and was afterwards perfectly well.

Worms in the Heads of Sheep, &c; by Mr. John Thorpe.
Phil. Trans. N^o 295. p. 1800.

IN dissecting the head of a sheep, there was found in the cells form'd between the *Lamina* of the *Os Frontis*, a worm represented by Plate XI. Fig. 32. which was an *Epode* and seem'd to be a species of the *Eula*, tho' very different from the common sort that breeds in putrid flesh; it was all of a fair pale colour, excepting its tail, which terminated a little obliquely in a plane, on which there were two remarkable black spots; besides two small white *Cornicula*; its head was armed with a pair of black sharp and crooked *Forcipes*, which in contracting and dilating its body, it draws in and exerts at pleasure; with these, in creeping it takes hold of the surface of the body on which it moves; and it draws itself forward in pretty large, protuberant, and somewhat flattish *Toruli* as in Fig. 33. fewer in number than those on its back, which swelling and relaxing alternately, seem'd instrumental to its motion, and to supply the place of feet; it look'd

of

of a clear, crystalline substance, and almost transparent; the membrane, that invested the cavity of the cells containing this worm, was very fat, and in most places separated from the bone; the blood-vessels appear'd turgid, and inflam'd; whereas, the membrane of the opposite cells, which had no communication with these, was thin, pellucid, adherent, and no ways preternaturally affected.

Mr. Bobart inform'd Mr. Thorpe, that three worms were found lodged in the same parts of a sheep's head, but in two distinct cells; the largest apart by itself, the other two in the adjoining cell; one of which was considerably less than the other, agreeing in form with the abovemention'd; of a whitish colour in general, with the two remarkable spots on the plane of the posterior part; but there was a shade of brown from the back down the sides, especially, in the older one, roundly turgid on the back, and flat underneath, divided into several *Annuli*, as these animals generally are; at the extremity of these protuberances, which serve instead of feet, there appear'd a little darkish brown spot on each side or edge; as they faded and wither'd, they chang'd to a light red or *Phœnecean* colour, and afterwards became brown.

Mouffet mentions worms yearly breeding in the brains of stags, goats and sheep, especially when fat, but supposing them to be generally known, he gives no description of them; unless from *Benedictus & Matthiolus*, that they are *Eulis maximis æquales, & ejusdem cum illis formæ*; tho' the worms meant by both these authors are not found in the brain, but as both agree, *sub Ungui in concavo circiter vertebram, quæ cervici innectitur Caput: Avicenna*, asserting the possibility of worms breeding in the head, says expressly, *multoties nascuntur in anteriore parti Capitis super locum qui est in strictura narium*; to which *Joubertus* adds, *ubi oves & capræ dicuntur perpetuè vermes habere, ut cervi in gutture*: This plainly shews the distinct places of their generating in the heads of stags and sheep, as well as it describes the particular cells, in which they are found in the *O Frontis* of the latter.

Trallian relates a memorable story from *Mosebion*; *Democritus* the *Athenian* applying himself to the oracle at *Delphos* for the epilepsy, receiv'd the following answer.

Μέγλον' ἀστράματος κεφαλῆς πομπήνιον ἔβλην
Μηκάδος ἀγρονομιοῖο, δέρας περιπαμ Βαλς μῆλυ
Ἐρπῆλα πολυπλεχόν ἑυρίην ἀπο κερσῆς

Tran-

Translated into Latin by Guinterius Andernacus, thus;

De Grege sume caprae majores curis alumne

Ex cerebro vermes, & ovis dato tergora circum

Multiplici vermi pecoris de fronte revulso.

Democrates not comprehending the hidden meaning of the oracle, referr'd it to Theognostes Democrasius; who recollecting that the head of a goat, near the basis of the brain, is naturally impregnated with worms, very sagely unfolded the mystery; advising him, in pursuance to Apollo's directions to procure one or three of them (for it seems it must be an odd number) by provoking the animal to sneeze, and wear them about his neck in the skin of a black sheep, as an amulet: It is not to be imagin'd, how worms seated at the basis of the brain, where Trallian places them, should be expell'd by sternutatories; the words of the oracle *Eupire atro xopons*, admit of a more favourable construction, and distinctly express the cavity over the nose; from whence by a passage, that opens into the palate and nostrils, they may easily be discharged by sneezing; and by the same passage they may as easily insinuate themselves, when small; or rather, be drawn up with the breath, when they are in the state of eggs, and be deposited in these cells; where animated by the vital heat, and nourish'd by preying on the membrane, in which they are included, they may more probably occasion the epilepsy in sheep and goats, (a distemper Hippocrates observes to be frequently incident to these animals, tho' he ascribes it to a different cause) than cure it in men: From hence, perhaps, we may be allow'd to account for those various instances, given by medicinal authors, of worms ejected at the nose by men and women; Benivenius, Fernelius, Zacutus Lusitanus, Ronssens, Trincavellius, Hildanus, Baptista Codronchus, Tulpius Verzascha, and others relate several cases of this kind; all agreeing, that they were attended with extreme pains in the head, Mania's *Lypothymies*, &c. which immediately ceas'd at their ejection.

It must be granted, that Aegineta, Gabucinus, Forestus, Borrellus, and particularly, Fulkius Angelinus, who wrote an entire discourse *de Vermis admirando per nares egresso*, very rationally conclude, that the worms they treated of, proceeded from the stomach or lungs, by their not being attended with those symptoms, nor affecting the head, as in the cases related by the abovemention'd authors; particularly, in that remarkable instance of Hollerius of a worm evacuated at the nose, *nulla tussi, nullo vomitu*

antecedente; which by the acute pain it produced, plainly discovered where it lay conceal'd.

Whether worms may generate in the brain, or its integuments, Mr. Thorpe will not determine; it is sufficient, supposing it possible, that there is no passage for them thence to the nose, where they are often found, as we are assur'd by several credible authors; Angelinus & Alsarius à Cruce place them *propè nascelatoria in strictura narium*; both seeming to imply that Sinus, which is more exactly describ'd by Avicenna; and which is to be understood of human heads, not those of brutes, but only as applied by Foubertus: What terrible symptoms, as *cephalæa*, *deliriums*, *epilepsies*, *syncope*s, *convulsions*, &c. a worm, with such sharp and piercing weapons may cause, by continually preying, and sporting on a part so exquisitely sensible, and nearly situated to the origin of sensation, as the membrane that invests the cavity of this Sinus, may be more easily imagin'd than explain'd.

Large Stones voided by the Urethra; by Dr. Bullen. Phil. Transf. N° 294. p. 1804. Translated from the Latin.

ONE Thomas Olton, who lived in the county of *Cheshire*, upwards of 78 years of age, being grievously afflicted with the stone in the bladder, made frequent applications to Dr. Bullen and other physicians for their advice, who us'd several medicines according to the exigency of the case, but all to no purpose; but at length (the patient having taken an excessive quantity of honey during his pain, to which alone he himself attributed his deliverance) in one of his most severe fits, he voided by the *Urethra* two stones, of much the same shape and size; which being joined together, the circumference one way was above three inches and $\frac{1}{2}$, and the other way three and $\frac{1}{4}$: An almost intolerable pain accompanied the voiding of the first stone, but scarcely was there any at all felt at the coming away of the second; which was owing to the *Urethra* being dilacerated by the former stone, whereby the latter had an easier passage; both these stones formed only one in the bladder, which was plain from their tallying, where they were broken off. *Schenkius* in his *Observat. cap. de calculo vesicæ* relates a similar case.

An Experiment of firing Gun-powder, on a red hot Iron in Vacuo Boyliano; by Mr. Hauksbee. Phil. Trans. N^o 295. p. 1806.

THE red hot iron being included in a recipient proper for the purpose, and the air exhausted (which was in about two minutes of time) the mercury then in the gauge standing at 29 inches and $\frac{1}{2}$, a quantity of gun-powder was immediately made to descend upon the iron, which continued on its surface some little time before it went off; and then it was observed not to fire all at once, and the last of the quantity that did so, seem'd to give the greatest flash; upon which the mercurial gauge was observed to descend something better than an inch, it rising again $\frac{1}{2}$ of the same; and upon several repetitions of the like quantity of gun-powder (the factitious air being always first exhausted) the appearances were very similar; again, upon exhausting the factitious air out of the receiver, and the mercury being elevated in the gauge as at first, three quantities of powder were made to descend upon the iron, whose explosion as well as the air produced from them, seem'd to be in proportion to the quantity of powder, the mercury in the gauge then subsiding to 26 inches; but upon dropping six quantities (the receiver being first exhausted as before) which not descending all at once, but successively as fast as possible, the quantities that first reached the still ignited iron taking fire, by their flame made an explosion of the whole, at once blowing up the recipient, tho' the weight of air incumbent thereon was equal to 144 pounds and $\frac{1}{2}$, reckoning the receiver at three inches and $\frac{1}{2}$ in diameter (but yet it was something more) which is a sufficient allowance for the want of height in the mercury; the gauge then standing at 29 and $\frac{1}{2}$, instead of 30, from which the calculation is made; the gun-powder made use of was the common glaz'd sort; and the weight of the six quantities, which removed the recipient, with so great a pressure incumbent thereon, was but seven grains, each quantity weighing something better than a grain; Mr. Hauksbee did not observe that the receiver broke before it reached the floor; it was thick lin'd with sulphureous and nitrous steams, so that the flashes of fire thro' the cloudiness of the glass seem'd very much to resemble faint lightning; the contents of the receiver was equal to about 25 ounces and $\frac{1}{2}$ of water, allowing for the bulk of the iron and the pedestal.

An Experiment to try the Quality of Air produced from Gun-powder, fired in Vacuo Boyliano; by the Same. Phil. Trans. N^o 295. p. 1807.

TO be satisfied, whether the factitious air of fired gun-powder is endued with any quality differing from common air, on December the 26th at noon Mr. *Hauksbee* included a red hot iron in *Vacuo*, the mercury in the gauge then standing at 29 inches and $\frac{1}{2}$; upon dropping the first quantity of gun-powder, by which is to be understood something more than a grain weight, its explosion made the mercury in the gauge descend about an inch, undulating but very little; the second quantity being let fall, the mercury subsided about $\frac{1}{2}$ of an inch; and so for several quantities following, it descended by pretty equal stages, till it had fallen about six or seven inches; and it was observed, that upon each quantity fir'd, the undulations of the mercury increas'd; but after it had subsided six or seven inches from 29 and $\frac{1}{2}$, its several descents became less, very little or nothing exceeding $\frac{1}{2}$ an inch, tho' the quantities fir'd were equal; but still the undulations increas'd, and the explosions manifestly did so too; till at last, the receiver seemed to be in great danger of being blown up by a single quantity; the undulations of the mercury being then increased to six or seven inches: Now, that 26 quantities, or 32 grains had been fired upon the iron, and the mercury in the gauge fallen to 12 $\frac{1}{2}$, Mr. *Hauksbee* carefully observed the gauge, which in seven minutes had ascended two inches $\frac{1}{2}$; the next five minutes it rose but one $\frac{1}{2}$ of an inch, and so less every five minutes successively; insomuch, that in an hour and 17 minutes it had attained but to 21 inches, the iron not being quite cold; at nine the same night he observed the gauge, and found the mercury elevated to 22 inches and $\frac{1}{2}$ precisely; next morning at nine it had attained to 22 and $\frac{1}{2}$, and so it continued all that day, the iron being then reduced to the temperature of the external air; so that from 12 and $\frac{1}{2}$ to 22 and $\frac{1}{2}$ seems to be the weight or spring of heat equal to about $\frac{1}{2}$ of an atmosphere of air, which would press the mercury upon the upper part of the gauge, but equal to such a degree of heat as was then contained in the receiver, when the gauge was fallen to 12 $\frac{1}{2}$; the remaining space from 22 and $\frac{1}{2}$ to 29 $\frac{1}{2}$ is supposed to be supplied with factitious air, and answers to about $\frac{1}{4}$ part of the whole contents of the receiver, which was equal to 25 ounces and $\frac{1}{2}$ of common water, allowing for the iron and pedestal; Mr. *Hauksbee* found that this air produced from gun-powder,

was

was actuated by heat and cold, as common air is; for holding his warm hands upon the receiver, the mercury in the gauge would immediately descend, and rise again when reduced to the temperature of the external air; this he repeated several times with the like success: What further occurs in this experiment, is, why the explosions of the like quantities of gun-powder should be greater when resisted by air, than *in Vacuo*, where nothing seems to hinder the extension of their flame?

The vitrified Salts of calcined Hay; by M. Leewenhoeck.
Phil. Trans. N^o 296. p. 1856.

MR. Chamberlayne gave M. Leewenhoeck an account that a large hay rick on *Salisbury Plain*, after some mowing and fermentation, took fire, and was wholly consumed; but that whereas the ashes commonly lie loose and scattered about, they were here condensed into a firm, but very light substance, which was judged to be vitrified and calcined together by a particular heat, of which substance there were several cart-loads.

M. Leewenhoeck viewing a piece of the said substance which was transmitted him by Mr. Chamberlayne, he supposed, that this vitrified matter was mostly fixed salts, which becoming fluid by the great heat, the vapours or moisture that arose from the bottom of the hay, or the particles thereof, which were not yet vitrified, had insinuated themselves into the fluid matter, and that upon the diminution of the heat, the said vapours being congealed and imprisoned in the vitrified matter, was the cause of its lightness; as we find by experience, that a very small particle of moisture, when rarified by heat, possesses a much larger space than it did before: For further satisfaction, whether it was not mostly fixed salt, M. Leewenhoeck put about the bigness of a pea of this matter upon a piece of charcoal, on which he blew the flame of a thick candle, till the said vitrified substance began to melt, and then he dropped it into a little copper-vessel, wherein there was a very small quantity of pure rain-water; this matter, with a little stirring dissolved in the water like powder or brick-dust; whereupon, he expected to find, that a great many salt particles would incorporate themselves with the water; after the water had stood some minutes, he skimmed off some of the top, and placing it on 8 or 10 several very clear glasses, and not above a drop of water on each, he saw, when the water was very near evaporated, a great many salt particles remaining of various figures; amongst which there were several whose superficies was an exact square, a few others were triangular, and others again were hex-

hexangular and long, which in proportion to their exceeding smallness, were very thick; so that they appeared to the naked eye, like little pieces of crystal, which was a very agreeable sight; he moreover, saw long particles, but very few, which resembled the small particles of salt-petre; he also saw several particles which were broad in the middle, and narrow at both extremities; but he did not always see those of this last sort, which were so thin, that they appeared like shadows to his eyes; besides the above-mentioned salt particles, there was a very great number of others, which were so small, that he could not discover their figure; but those that were a little larger than the rest had some sort of figure; from whence he concluded, that the remainder was also salt particles; besides, where he saw one of these large salts (which was no bigger than the thousandth part of a coarse grain of sand) lie, he could perceive no others round them for the space of a hair's breadth; and as he could discover about the said salt particles divers circles, which he judged to be coagulated salts, that by such an accession grew still larger and larger; he was confirmed in his opinion, that the small particles were mostly salts; M. *Leewenboeck* took a small particle of the above-mentioned vitrified matter, which had been before in a glowing heat, ready to melt and putting it again into a strong fire, when melted, it began to change itself into a globular figure, whereupon several air-bubbles appeared one after another, forcing themselves a passage, which shut up again after they were broken out; and this he continued till the matter became perfectly globular.

M. *Leewenboeck* asking a certain person who had a hay-rick, (containing upwards of 100 loads, and each load 1000 weight) burnt down, what there remained on the ground where it stood? Who answered, a light glazy stuff, very brittle, which upon walking over it cracked and broke under his feet, and upon putting a little of it into his mouth, he could perceive a saltness therein. This countryman told M. *Leewenboeck*, that there is great danger of such hay-ricks taking fire, if put up before the hay is dry; and he gave an instance of one, tho' it did not break out into a flame, yet it smoaked very much; and being pulled down, when they came to the middle of it, they found some of the hay burnt, and some part thereof was clear ashes, together with a ball of vitrified matter; but he added, that the fire was quenched as he supposed for want of air.

Insects in the Bark of decaying Elm and Ash-trees; by Sir Matthew Dudley. Phil. Trans. N^o 296. p. 1839.

SIR *Matthew Dudley* had transplanted divers elms, upwards of six inches diameter, which for the first two or three years thrived very well; but there happening a very dry season in *July* or *August*, he observed, that one of those elms, which stood very shallow, and on pretty high ground, looked very sickly; its leaves became yellow, and began to fall off, which made him examine the bark with a knife; when he found, that the inside thereof was not so green, but of a more reddish colour than the rest were; and between it and the tree it was not so moist, the bark sticking very close to the wood; but what was most remarkable, he discovered a great many small black flies of the beetle-kind (having a hard case or membrane, under which their thin long wings were contracted and thereby covered) between the bark and the tree; and viewing it more narrowly, he observed, that these flies had made their way thither by perforating the bark in a vast many places; and the holes were easily discernible on the outside, which were as big as that a large pin's-head could enter them; he found some of the flies just entering, and which had not got quite thro' the bark; others, had made some progress between the tree and the bark, which appeared like a channel; Sir *Matthew* despaired of ever recovering the tree; however, he caused his servants to pour about two hogsheds of water thereon, and stir the earth about the roots, and lay some rotten litter thereon, to defend it from the scorching rays of the sun; upon this, the tree recovered again in some measure its verdure that year, and next year it yielded very good shoots, and so it continued, till some short time after, that there happened a very dry summer, when Sir *Matthew* observed divers of his trees look sickly in the beginning of *August*, and particularly the above-mentioned one; and making the same tryal on them all, he found the bark stuck close to the wood, with very little moisture between them, and vast numbers of those small flies, which had pierced the bark in a great many places; he ordered the earth about the roots to be loosened as formerly, and about two hogsheds of water to be poured on each; and viewing them next morning, he found the outside of the trees almost covered with bees, wasps, and large black flies, commonly called flesh-flies, who were all busy in sucking the juice or sap (which ran plentifully out at every hole, that the above-said small flies had made in the bark) which was very glutinous, and as sweet as honey; he again examined the bark

bark, between which and the wood he found it very moist, and all those little flies either gone or drowned in their new habitations, by the sudden rise of the sap; and the said tree recovered. Upon examining several trees that looked more sickly than the rest, he found that there was hardly any greenness left in the bark, and that there remained no moisture between it and the wood; but the bark stuck so close to the wood, that it could hardly be separated therefrom; and the bark throughout the whole tree was pierced by the aforesaid flies, each of which made from the hole, where it entered a straight perpendicular channel upwards, about two inches long or something better, very little, if at all, larger than just to move themselves forwards in; for he observed that all of them, if disturbed, came out backwards; there were small channels, as close to each other as they possibly could, yet so as to be distinct, running horizontally all along on each side this channel, at the extremity of every one of which there was a maggot, exactly of the same size therewith, very lively, whitish and almost transparent; these trees tho' well watered, received no benefit thereby, but died: It is to be observed, that there were none of these flies to be found in such trees whose leaves looked green and healthful; the reason of which Sir *Matthew* supposes to be this, that whilst there was a sufficient moisture in the earth about the roots, to supply the tree with a due quantity of sap, so thin and diluted that it was proper and capable of being conveyed into the smallest twigs and leaf-vessels, the leaves retained their verdure, and the tree flourished; but when by reason of the dry season, that supply failed, and the sun perpetually exhale the thinner and more watry parts thereof, thro' the bark, the sap already in the tree became insufficient in quantity, as well as improper, by reason of its thickness, to supply or enter into all those small vessels; the leaves lost their greenness, and fell off, and the sap became thick and very sweet (which he found it is not, when it is duly diluted, and when the tree is healthful) which invited those flies to make their way to it, as a proper nursery to bring up their young ones, which Sir *Matthew* takes those little maggots to be; he also supposes, that the eggs were first laid in the large channel (and perhaps, regularly deposited at their proper distances, in the sides thereof) and after being hatched, made those small channels themselves, since they are no ways capable of receiving the old fly; and that the maggot is always found at the farthest extremity of the little channel, and the rest of it is quite filled with very small particles, which when dry, become a fine powder; and Sir *Matthew* supposes it

to be either the excrement of the worm, or particles of the bark ground small by the teeth of the worm, to make its way forwards, and rejected as not being proper aliment, or both; about the middle of *October* he found that these little white maggots, and consequently their channels, which they exactly filled, were grown much larger, and had made their progress from the place where they were first hatched, which was close to, or upon the very wood, almost to the very outside of the bark of the elm, which is usually pretty thick; and in every one of those perpendicular channels above-mentioned, he found the mother-fly lying dead, for the most part towards the entrance of the said channel.

From these observations Sir *Matthew Dudley* was led to view the fuel that lay on the ground in his yard; and in all the elms which were felled last spring, he found that the bark thereof was as much perforated; and that the same mother-channels and the little channels proceeding therefrom, were full of maggots, which had also made their way almost to the outside of the bark; observing some elms that had lain much longer in the yard, and taking off the bark, he found the same tracks both of the mother-flies and maggots; and that at the extremities of almost all the channels formed by the maggots, where they had subsisted long enough to come to perfection, the bark was perforated quite thro' by a hole just the bigness of the channel, and nothing left remaining but a sort of whitish pellicle, pretty tough, exactly of the colour and size of the maggot, at the entrance of the hole; and the rest of the forsaken channel was quite filled with what Sir *Matthew* calls the excrement of the maggot: Then examining the ash-wood, which had lain sometime in the yard, it being young and its bark pretty smooth, he at first sight perceived it full of small holes, and upon separating it from the tree, he found just the same sort of work, as in the elm, and by the same sort of fly, having observed several of the mother-flies dead in their channels, as also the same empty skins or membranes at the extremities of the other channels; only with this difference, that whereas, in the elm all the mother-channels were perpendicular, and the maggot-channels horizontal, here in the ash it was just the contrary; this Sir *Matthew* took at first to be accidental, and peculiar to that piece of wood; but upon examining upwards of 100 pieces of different trees, and felled at different times, he found that it held exactly true in them all; he observed several oak and maple-trees, some of which had been felled in winter, and others in summer,

and the bark remaining thereon, but he could find no such thing in either of them.

Plate XII. Fig. 1. represents the bark of the ash. Fig. 2. the bark of the elm. Fig. 3. the worm as big as the life lying on its back. Fig. 4. the mother-fly as big as the life, with its belly upwards. Fig. 5. and 6. the worm and fly with their backs upwards. Fig. 7. and 8. the worm magnified. Fig. 9. the mother-fly magnified.

A Leaden Coffin found in a Roman Burying-place, near York; by Mr. Ralph Thoresby. Phil. Trans. N^o 294. p. 1864.

AT York, without *Boutham-bar*, was found in the Roman burying-ground, a remarkable leaden-coffin, which by the circumstances seems to have been for a person of quality; it was nine foot deep in the ground, whereof six were clay and three a black earth; the leaden-coffin which was about seven foot long, was inclosed in a vastly strong one, made of oak-planks, about two inches and $\frac{1}{2}$ thick, which besides the rivettings, were tacked together with brags, or large iron-nails, some of which Mr. *Thoresby* pulled out of the planks and had them by him; they were four inches long, the heads not die-wise, as large nails now are, but quite flat, and an inch broad; he also had another nail somewhat different, being $\frac{1}{2}$ an inch broad, and thin, somewhat in the form of a wedge, the head was not round as the others, but something like the modern draw-nails; but these old ones were generally square, the four sides being of an equal breadth; several of them were almost consumed with rust, the outside of the planks was rotten, but the heart of the oak was sound, and the lead was very fresh and pliable; whereas, one that was found a year before this (whereof Mr. *Thoresby* had also a sample) was brittle and almost entirely consumed, having had no planks to defend it; but what was most surprising was, that the bones should be entire, tho' probably interred 1500 years ago; for it is above so many centuries, since the custom of burning gave place to that more natural one of burying their dead, which according to M. *Muret*, was re-introduced by the *Antonines*.

Mr. *Thoresby* had a thigh-bone, which was exceeding light, as also a lower jaw-bone, which had all the teeth; but tho' the bones were light, the double coffin was so heavy, that they were obliged to drag it out of its old dormitory with a team of horses.

Ex.

Experiments on the production and propagation of Light from the Phosphorus in Vacuo; by Mr. Francis Hauksbee. Phil. Trans. N^o 296. p. 1863.

Exp. I. **M**R. Hauksbee having provided a dark room, drew some lines on a piece of blue paper with the Phosphorus, which became immediately luminous in the open air, having a continual undulating motion, this being placed under a receiver, after some few exhaustions, the undulation ceased, but the luminous quality appeared to be in a great measure increased; the receiver being further exhausted, it became manifestly brighter; and so continued, till on the admission of air (which was gradually done) the light diminished sensibly all the while; but upon the repetition of the experiment, the gentlemen who saw it were of opinion, that it did not appear altogether so brisk, or so vivid as at first.

Experiment II. To two or three pieces of Phosphorus in a glass dish was added a small quantity of oil of vitriol, tartar per deliquium, and oil of cloves, which mixture fired the Phosphorus in the open air; but upon adding a little common water, the flame was extinguished; this preparation being included in a receiver, very little light appeared; but upon exhausting the air, it became very apparent, and emitted vivid steams; at the same time the ingredients in the dish very much resembled a boiling flame, exhibiting a strong light; so that several objects near it were thereby distinguishable, and continued so, till the air was re-admitted, at which time it became opaque; nor would shaking the engine (by which means the mixture in the dish was put in motion) produce any sensible recovery of light.

Experiment III. A small quantity of the above-mentioned ingredients being put into a bottle with a narrow neck, and included under a receiver, it then appeared with very little light; but upon exhausting the air, the Phosphorus began to be luminous, and continued to increase, in proportion to the rarification of the air, issuing out of the bottle in a pyramidal form; at last, notwithstanding the receiver was well exhausted, the vivid steams that were then emitted were so fine and subtil as to ascend in to thin a medium, reaching the upper parts of the receiver (which was not tall) and descending again by the sides thereof; upon letting in the air, the light quite vanished; and it would have been to no purpose (as Mr. Hauksbee often tried) to have waited in expectation of its recovery in the open air.

Pewter Money coined in Ireland, by Mr. Thoresby. Phil. Transl. N^o 297. p. 1875.

MR. Thoresby had a crown piece of pewter, of the late king James's Irish coin, inscribed *melioris tessera fatis*, which was sent him by one Mr. Putland, who found it in the treasury at Dublin, and whose account of it is as follows; viz. That king James, having turned all the brass guns of Ireland, and all the brass, and copper vessels of Protestants, that he could seize into coin; that is, half-crowns, somewhat bigger than an English half-penny, shillings broader, but not so thick as a farthing, and six pences in proportion; it was ordered, that they should pass current in all payments, even in bonds, and discharge of judgments and statutes; so that men absconded, to avoid receiving their debts; but this stock of metal being all spent (which he began to coin in June 1689) and their being no circulation to bring them back into his treasury, he call'd in all that he had coin'd; and the half-crowns, which before were stamped with a face, were re-stamped with his effigies on horse-back, and then paid out to those who brought them in, as crowns; and the smaller coins were melted down, and re-coined again under the same denominations, but with less metal; after the turn was served by this stratagem, he had not wherewithal to import copper and brass; but for want of it, fell foul on the pewter dishes, &c. and the piece I sent you was coined for five shillings, and the proclamation to make it passable was ready prepared; but king William passing the Boyne, prevented their proclaiming it.

This valuable curiosity has the same inscription on both sides, as the common brass-crowns; but there is this legend added on the rim of it, MELIORIS TESSERA FATI ANNO REGNI SEXTO.

A Synopsis of the Astronomy of Comets; by Mr. Edm. Halley. Phil. Transl. N^o 297. p. 1882. Translated from the Latin.

THE ancient Egyptians and Chaldeans (if we may credit Diodorus Siculus) being furnished with a long series of observations, could predict the rising, or appearing of comets; but as they also are said by the same arts to have foretold earthquakes and tempests, it is past all doubt, that their knowledge in these matters was rather the result of astrological calculations, than of astronomical theories of the motions of the celestial bodies;

dies; and the *Greeks*, who were the conquerors of both these nations, scarcely found any other sort of learning amongst them than this; so that it is to the *Greeks* themselves, as the inventors, especially to the great *Hipparchus*, that we owe this astronomy, which is now so greatly improved; but yet *Aristotle's* opinion (*viz.* that comets were nothing else but sublunary vapours or airy meteors) prevailed so far amongst the *Greeks*, that this sublimest part of astronomy lay altogether neglected; since none could think it worth while to observe, and give an account of the wandering and uncertain paths of vapours floating in the *Aether*; whence it is, that we have nothing certain handed down from the ancients concerning the motion of comets; but *Seneca* the philosopher, considering the *Phænomena* of two remarkable comets of his time, made no scruple to place them amongst the celestial bodies, taking them to be stars of equal duration with the world itself; tho' he owns, that their motions were regulated by laws not then discovered; at length, he foretels (which has proved no vain prediction) that time and diligence would unfold these mysteries to some future ages, who would be surpris'd to find the ancients could be ignorant of them, after that some lucky interpreter of nature should have pointed out in what parts of the heavens comets wandered, and shewn what, and how great they were; yet most astronomers differed from *Seneca* in this; and *Seneca* himself has not left any account of the *Phænomena* of their motion, whereby he might support his hypothesis, nor assigned the time of their appearing, which might enable posterity to determine any thing in this matter: So that after *Mr. Halley* had turned over several histories of comets, he could find nothing at all, that could give any assistance herein, before *A. D.* 1337, when *Nicephorus Gregoras* an historian and astronomer of *Constantinople* had pretty accurately described the path of a comet amongst the fixed stars; but he too loosely assigns the time, so that this undetermined comet only deserves to be inserted in the catalogue, on account of its having appeared almost 400 years ago; the next comet *A. D.* 1472, which moved the swiftest of all, and came nearest to the earth was observed by *Regiomontanus*; this comet (so frightful on account both of the magnitude of its body and its tail) in the space of a day moved 40° of a great circle in the heavens, and it is the very first of which, any proper observations have been handed down to us; for all those who considered comets before *Tycho Brahe*, that great restorer of astronomy, supposed them to be below the moon, and so took but little notice of them, imagining them to be

no other than vapours : But in the year 1577, *Tycho Brahe* applying himself seriously to the study of astronomy, and having procured large instruments for making celestial measurements, with greater exactness and certainty than the ancients could ever hope for; there appeared a pretty remarkable comet, to the observation of which *Tycho* vigorously applied himself, and he found by several unquestionable trials, that it had no sensible diurnal parallax; and consequently, that it was not only no aerial vapour, but much higher than the moon; nay, and might be reckoned amongst the planets for any thing that appeared to the contrary, notwithstanding the cavilling opposition of some schoolmen; to *Tycho* succeeded the sagacious *Kepler*, who having the advantage of *Tycho's* observations, found out the true and physical system of the world, and vastly improved astronomy; for he demonstrated, that all the planets revolved in planes passing thro' the center of the sun, and described elliptical curves, observing this law, that the areas of the elliptic sectors taken at the center of the sun, in the *Focus* of the ellipsis, are always proportional to the times, wherein the correspondent arches are described; he also discovered, that the distances of the planets from the sun are in the sesquialteral ratio of their periodical times, or that the cubes of the distances are as the squares of the times; this great astronomer had the opportunity of observing two comets, one of which was very remarkable; and from his observations of these, he concluded, from several indications of an annual parallax, that comets move freely thro' the planetary orbits, with a motion not much different from a rectilinear one, but which he could not then determine: Next *Hevelius*, a noble emulator of *Tycho*, following *Kepler's* steps, embraced the same hypothesis of the rectilinear motion of comets, he himself having very accurately observed several of them; yet he complained, that his calculations did not altogether agree with the appearances in the heavens, and he was aware that the path of comets was incurvated towards the sun: At length, that extraordinary comet of 1680 descended from a vast distance, and as it were, in a perpendicular line towards the sun, and ascended from him again with an equal velocity; this comet appearing constantly for four months, by the peculiar and remarkable curvity of its orbit, seemed above all others the most adapted for investigating the theory of their motion; and the Royal observatories at *Paris* and *Greenwich* being founded some time before, and committed to the care of the most famous astronomers, the apparent motion of this comet was (as far as human sagacity could reach) very

accurately observed by M. *Cassini* and Mr. *Flamsteed*: Not long after, that incomparable geometrician Sir *Isaac Newton*, not only demonstrated that what *Kepler* had found, did necessarily obtain in the planetary system, but likewise that all the *Phenomena* of comets plainly follow from the same principles, which he fully illustrated by the above-mentioned comet of 1680; and at the same time shewed the method of geometrically constructing the orbits of comets, and to the surprise of all men, solved a problem, whose intricacy rendered it worthy of so great a genius; and he proves that this comet revolved round the sun in a parabolic orb, in such a manner that the areas estimated at the centre of the sun were proportional to the times: Mr. *Halley* pursuing the steps of so great a man, attempted (and he presumes not without success) to bring the same method to an arithmetical calculation; for having collected together all the observations of comets, he obtained the following table, the result of an almost immense calculation.

The following table needs no explication, since the titles sufficiently express what the numbers mean; but the perihelion distances are estimated in such parts, of which the mean distance of the earth from the sun contains 100000.

Comet	Year	Perihelion Distance	Time of Revolution	Time of Appearance	Time of Disappearance
1	1531	100000	5370	1531	1532
2	1556	100000	5370	1556	1557
3	1577	100000	5370	1577	1578
4	1607	100000	5370	1607	1608
5	1652	100000	5370	1652	1653
6	1680	100000	5370	1680	1681
7	1697	100000	5370	1697	1698
8	1702	100000	5370	1702	1703
9	1744	100000	5370	1744	1745
10	1769	100000	5370	1769	1770
11	1785	100000	5370	1785	1786
12	1790	100000	5370	1790	1791
13	1811	100000	5370	1811	1812
14	1818	100000	5370	1818	1819
15	1822	100000	5370	1822	1823
16	1828	100000	5370	1828	1829
17	1835	100000	5370	1835	1836
18	1843	100000	5370	1843	1844
19	1845	100000	5370	1845	1846
20	1847	100000	5370	1847	1848
21	1848	100000	5370	1848	1849
22	1850	100000	5370	1850	1851
23	1851	100000	5370	1851	1852
24	1852	100000	5370	1852	1853
25	1853	100000	5370	1853	1854
26	1854	100000	5370	1854	1855
27	1855	100000	5370	1855	1856
28	1856	100000	5370	1856	1857
29	1857	100000	5370	1857	1858
30	1858	100000	5370	1858	1859
31	1859	100000	5370	1859	1860
32	1860	100000	5370	1860	1861
33	1861	100000	5370	1861	1862
34	1862	100000	5370	1862	1863
35	1863	100000	5370	1863	1864
36	1864	100000	5370	1864	1865
37	1865	100000	5370	1865	1866
38	1866	100000	5370	1866	1867
39	1867	100000	5370	1867	1868
40	1868	100000	5370	1868	1869
41	1869	100000	5370	1869	1870
42	1870	100000	5370	1870	1871
43	1871	100000	5370	1871	1872
44	1872	100000	5370	1872	1873
45	1873	100000	5370	1873	1874
46	1874	100000	5370	1874	1875
47	1875	100000	5370	1875	1876
48	1876	100000	5370	1876	1877
49	1877	100000	5370	1877	1878
50	1878	100000	5370	1878	1879
51	1879	100000	5370	1879	1880
52	1880	100000	5370	1880	1881
53	1881	100000	5370	1881	1882
54	1882	100000	5370	1882	1883
55	1883	100000	5370	1883	1884
56	1884	100000	5370	1884	1885
57	1885	100000	5370	1885	1886
58	1886	100000	5370	1886	1887
59	1887	100000	5370	1887	1888
60	1888	100000	5370	1888	1889
61	1889	100000	5370	1889	1890
62	1890	100000	5370	1890	1891
63	1891	100000	5370	1891	1892
64	1892	100000	5370	1892	1893
65	1893	100000	5370	1893	1894
66	1894	100000	5370	1894	1895
67	1895	100000	5370	1895	1896
68	1896	100000	5370	1896	1897
69	1897	100000	5370	1897	1898
70	1898	100000	5370	1898	1899
71	1899	100000	5370	1899	1900
72	1900	100000	5370	1900	1901
73	1901	100000	5370	1901	1902
74	1902	100000	5370	1902	1903
75	1903	100000	5370	1903	1904
76	1904	100000	5370	1904	1905
77	1905	100000	5370	1905	1906
78	1906	100000	5370	1906	1907
79	1907	100000	5370	1907	1908
80	1908	100000	5370	1908	1909
81	1909	100000	5370	1909	1910
82	1910	100000	5370	1910	1911
83	1911	100000	5370	1911	1912
84	1912	100000	5370	1912	1913
85	1913	100000	5370	1913	1914
86	1914	100000	5370	1914	1915
87	1915	100000	5370	1915	1916
88	1916	100000	5370	1916	1917
89	1917	100000	5370	1917	1918
90	1918	100000	5370	1918	1919
91	1919	100000	5370	1919	1920
92	1920	100000	5370	1920	1921
93	1921	100000	5370	1921	1922
94	1922	100000	5370	1922	1923
95	1923	100000	5370	1923	1924
96	1924	100000	5370	1924	1925
97	1925	100000	5370	1925	1926
98	1926	100000	5370	1926	1927
99	1927	100000	5370	1927	1928
100	1928	100000	5370	1928	1929

Year of the Com.	Re.	St.	Gr.	Br.	St.	Gr.	Br.	St.	Gr.	Poor from the Sub.	Of the Poor, from the Sun	Festival at London.
1337	II	24	21	O	32	11	O	O	O	40666	9-609236	June 2 6 25
1472	O	11	46	28	5	20	O	O	O	54273	9-73454	Feb. 28 22 23
1531	O	19	25	O	17	36	O	O	O	56700	9-753583	Aug. 24 21 18½
1532	II	20	27	O	32	36	O	O	O	50910	9-706808	Oct. 19 22 12
1556	III	23	42	O	32	6	30	O	O	46390	9-666424	Apr. 21 20 23
1577	V	25	52	C	74	32	45	O	O	18342	9-263447	Oct. 26 18 45
1580	V	18	57	20	64	40	O	O	O	59628	9-775450	Nov. 28 15 00
1585	O	7	42	30	6	4	O	O	O	109358	9-058850	Sept. 27 19 20
1590	III	15	50	40	29	40	40	O	O	57661	9-760882	Jan. 29 3 45
1596	III	12	12	30	55	12	O	O	O	51293	9-710058	July 31 19 55
1607	O	20	21	O	17	2	O	O	O	58680	9-768490	Oct. 16 3 50
1618	II	16	1	O	37	34	O	O	O	37975	9-579496	Oct. 29 12 23
1652	II	28	10	O	79	28	O	O	O	84750	9-928140	Nov. 2 15 40
1661	II	22	30	30	32	35	50	O	O	44851	9-651772	Jan. 16 23 41
1664	II	21	14	O	21	18	30	O	O	102575f	9-011044	Nov. 24 11 52
1665	III	18	02	O	76	05	O	O	O	10649	9-027309	Apr. 14 5 15½
1672	O	27	30	30	83	22	10	O	O	69739	9-843476	Feb. 20 8 37
1677	III	26	49	10	79	03	15	O	O	28039	9-448072	Apr. 25 00 37½
1680	O	2	2	O	60	56	O	O	O	00612f	9-787106	Dec. 8 00 6
1682	O	21	16	30	17	56	O	O	O	58328	9-765877	Sept. 4 07 39
1683	III	23	23	O	83	11	O	O	O	56010	9-748343	July 3 2 50
1684	V	28	15	O	65	48	40	O	O	96015	9-982339	May 29 10 16
1686	X	20	34	40	31	21	40	O	O	32500	9-511883	Sept. 6 14 33
1698	V	27	44	15	11	46	O	O	O	69129	9-839660	Oct. 8 16 57

A general Table to compute the Motion of Comets in a parabolic Orbit.

mean Met.	Angle from Perihel.			Log. dist. from the Sun.	mean Met.	Angle from Perihel.			Log. dist. from the Sun.
0	Gr.	Min.	Sec.		0	Gr.	Min.	Sec.	
1	1	31	40	0. 000077	31	42	55	07	0. 062400
2	3	3	15	0. 000209	32	44	3	16	0. 065835
3	4	34	43	0. 000694	33	45	10	26	0. 069316
4	6	6	0	0. 001231	34	46	16	35	0. 072839
5	7	37	1	0. 001921	35	47	21	36	0. 076396
6	9	7	44	0. 002759	36	48	25	33	0. 079984
7	10	38	2	0. 003745	37	49	28	29	0. 083604
8	12	7	35	0. 004876	38	50	30	23	0. 087249
9	13	37	17	0. 006151	39	51	31	11	0. 090912
10	15	6	6	0. 007564	40	52	30	54	0. 094594
11	16	34	20	0. 009115	41	53	29	42	0. 098298
12	18	1	54	0. 010798	42	54	27	32	0. 102019
13	19	28	47	0. 012609	43	55	24	22	0. 105752
14	20	54	53	0. 014550	44	56	20	11	0. 109490
15	22	20	14	0. 016607	45	57	15	5	0. 113240
16	23	44	43	0. 018783	46	58	9	2	0. 116995
17	25	8	22	0. 021072	47	59	2	5	0. 120756
18	26	31	7	0. 023470	48	59	54	13	0. 124518
19	27	52	55	0. 025969	49	60	45	26	0. 128278
20	29	13	52	0. 028551	50	61	35	45	0. 132035
21	30	33	39	0. 031263	51	62	25	14	0. 135792
22	31	52	31	0. 034045	52	63	13	50	0. 139541
23	33	10	23	0. 036916	53	64	1	38	0. 143288
24	34	27	12	0. 039864	54	64	48	38	0. 147025
25	35	42	59	0. 042892	55	65	34	50	0. 150762
26	36	57	41	0. 045989	56	66	20	14	0. 154482
27	38	11	20	0. 049154	57	67	04	51	0. 158192
28	39	23	56	0. 052383	58	67	48	22	0. 161890
29	40	35	26	0. 055668	59	68	31	51	0. 165578
30	41	45	50	0. 059010	60	69	14	16	0. 169254

A general Table to compute the Motion of Comets in a parabolic Orbit.

mean Mot.	Angle from Perihel.			Log. dist. from the Sun.	mean Mot.	Angle from Perihel.			Log. dist. from the Sun.
o	gr.	'	"		o	gr.	'	"	
61	69	55	58	0. 172914	91	86	20	34	0. 274176
62	76	36	50	0. 176557	92	86	46	20	0. 277239
63	71	17	16	0. 180188	93	87	11	43	0. 280284
64	71	56	56	0. 183893	94	87	36	45	0. 283306
65	72	35	57	0. 187494	95	88	01	27	0. 286308
66	73	14	15	0. 190978	96	88	25	49	0. 289293
67	73	51	59	0. 194540	97	88	49	48	0. 292252
68	74	29	6	0. 198085	98	89	13	32	0. 295201
69	75	05	38	0. 201614	99	89	36	54	0. 298122
70	75	41	35	0. 205122	100	90	00	00	0. 301030
71	76	16	56	0. 208612	102	90	45	14	0. 306782
72	76	51	43	0. 212080	104	91	29	18	0. 312460
73	77	25	57	0. 215529	106	92	12	14	0. 318060
74	77	59	41	0. 218963	108	92	54	4	0. 323587
75	78	32	54	0. 222378	110	93	34	52	0. 329042
76	79	5	35	0. 225769	112	94	14	40	0. 334424
77	79	37	45	0. 229142	114	94	53	30	0. 339736
78	80	9	23	0. 232488	116	95	31	22	0. 344979
79	80	40	34	0. 235809	118	96	8	22	0. 350153
80	81	11	16	0. 239127	120	96	44	30	0. 355261
81	81	41	31	0. 242416	122	97	19	48	0. 360306
82	82	11	19	0. 245684	124	97	54	17	0. 365284
83	82	40	40	0. 248933	126	98	28	00	0. 370200
84	83	9	34	0. 252159	128	99	00	57	0. 375052
85	83	38	4	0. 255366	130	99	33	11	0. 379842
86	84	6	8	0. 258552	132	100	4	43	0. 384576
87	84	33	49	0. 261720	134	100	35	45	0. 389252
88	85	1	5	0. 264865	136	101	5	48	0. 393868
89	85	27	58	0. 267989	138	101	35	22	0. 398428
90	85	54	27	0. 271092	140	102	4	19	0. 402936

A general Table to compute the Motion of Comets in a parabolic Orbit.

mean Mot.	Angle from Perihel.			Log. dist. from the Sun.	mean Mot.	Angle from Perihel.			Log. dist. from the Sun.
o	gr.	"			o	gr.	"		
142	102	32	41	0. 407380	204	113	37	25	0. 523406
144	103	00	31	0. 411784	208	114	9	52	0. 529705
146	103	27	47	0. 416132	212	114	41	23	0. 535886
148	103	54	31	0. 420430	216	115	12	02	0. 541958
150	104	20	43	0. 424676	220	115	41	51	0. 547922
152	104	46	22	0. 428866	224	116	10	52	0. 553782
154	105	11	33	0. 433012	228	116	39	7	0. 559538
156	105	36	16	0. 437110	232	117	6	38	0. 565199
158	106	00	32	0. 441164	236	117	33	27	0. 570762
160	106	24	23	0. 445178	240	117	59	35	0. 576233
162	106	47	47	0. 449144	244	118	25	5	0. 581616
164	107	10	44	0. 45306	248	118	49	57	0. 586912
166	107	33	17	0. 456936	252	119	14	14	0. 592122
168	107	55	27	0. 460772	256	119	37	56	0. 597252
170	108	17	14	0. 464208	260	120	1	6	0. 602301
172	108	38	37	0. 468318	264	120	23	44	0. 607274
174	108	59	39	0. 472030	268	120	45	52	0. 612174
176	109	20	20	0. 475705	272	121	7	30	0. 616998
178	109	40	40	0. 479340	276	121	28	39	0. 621750
180	110	00	40	0. 482937	280	121	49	22	0. 626438
182	110	20	20	0. 486498	284	122	9	38	0. 631056
184	110	39	41	0. 490022	288	122	29	28	0. 635608
186	110	58	44	0. 493512	292	122	48	54	0. 640098
188	111	17	28	0. 496965	296	123	7	57	0. 644525
190	111	35	55	0. 500384	300	123	26	36	0. 648893
192	111	54	05	0. 503769	310	124	11	40	0. 659559
194	112	11	58	0. 507121	320	124	54	36	0. 669880
196	112	29	34	0. 510441	330	125	35	34	0. 679876
198	112	46	55	0. 513729	340	126	14	44	0. 689568
200	113	4	00	0. 516984	350	126	52	12	0. 698970

A general Table to compute the Motion of Comets in a parabolic Orbit.

mean Mot.	Angle from Perihel.	Log. dist. from the Sun.	mean Mot.	Angle from Perihel.	Log. dist. from the Sun.
°	gr. ' "		°	gr. ' "	
360	127 28 6	0.708104	820	141 49 24	0.970836
370	128 2 33	0.716976	840	142 10 00	0.978397
380	128 35 38	0.725606	860	142 29 56	0.985771
390	129 7 27	0.734006	880	142 49 10	0.992970
400	129 38 4	0.742186	900	143 7 48	1.000000
410	130 7 34	0.750160	920	143 25 51	1.006871
420	130 36 2	0.757930	940	143 43 21	1.013586
430	131 3 30	0.765516	960	144 00 18	1.020152
440	131 30 2	0.772918	980	144 16 46	1.026583
450	131 55 41	0.780148	1000	144 32 46	1.032870
460	132 20 30	0.787216	1500	149 26 8	1.158188
470	132 44 32	0.794122	2000	152 26 15	1.246058
480	133 7 50	0.800882	2500	154 32 20	1.313702
490	133 30 25	0.807494	3000	156 7 27	1.368671
500	133 52 20	0.813969	3500	157 22 49	1.414976
520	134 34 18	0.826522	4000	158 24 36	1.454950
540	135 14 0	0.838600	4500	159 16 36	1.490122
560	135 51 28	0.850187	5000	160 1 12	1.521521
580	136 27 6	0.861369	5500	160 40 5	1.549874
600	137 00 57	0.872155	6000	161 14 24	1.575718
620	137 33 13	0.882575	6500	161 45 00	1.599400
640	138 3 58	0.892649	7000	162 12 34	1.621417
660	138 33 21	0.902401	7500	162 37 34	1.641831
680	139 1 29	0.911866	8000	163 00 23	1.660922
700	139 28 23	0.921012	8500	163 21 20	1.678834
720	139 54 16	0.929907	9000	163 40 42	1.695708
740	140 19 5	0.938549	9500	163 58 38	1.711662
760	140 42 56	0.946951	10000	164 15 20	1.726784
780	141 05 55	0.955124	50000	170 52 0	2.197960
800	141 28 3	0.963082	100000	172 45 44	2.399655

The motions of all comets for more of them that have hitherto been observed, have been computed from the law of the parabola.

The Construction and Use of the general Table.

As the planets revolve in elliptic orbits round the sun, placed in their common *Focus*, so likewise do comets in parabolic ones; in such a manner, as that equal areas are described in equal times; seeing then all parabola's are similar, if any determinate part of the area of a given parabola be divided into any number of parts, a like division will be made in all parabola's under the same angles, and the distances will be proportional; therefore Mr. *Halley's* table will serve for all comets; the manner of the calculation of which is as follows: Let *S* in Plate XII. Fig. 10, represent the sun; *POC* the orbit of the comet; *P* the *Perihelion*; *O* the place of the comet, being a quadrant distant from the *Perihelion*; *C* any other place; join *CP*, *CS*; let *ST* and *SR* be equal to *CS*; and drawing the right lines *CR*, *CT* (of which *CT* is a tangent to the curve, and *CR* a perpendicular) let fall the perpendicular *CQ* upon the axis *PSR*: Now having any area, as *COPS* given, to find the angle *CSP* and the distance *CS*; because, from the nature of a parabola, the right line *RQ* is always equal to half the *Latus rectum*; let the *Latus rectum* be put $= 2$, then *QR* will be $= 1$; let the right line *CQ* be $= z$; therefore, *PQ* will be $= \frac{1}{2} z^2$, and the parabolic segment *COP* will be $= \frac{1}{2} z^3$; but the triangle *CSP* will be $= \frac{1}{2} z$; consequently the mixtilinear area *COPS* will be $= \frac{1}{2} z^3 + \frac{1}{2} z = a$, and $z^3 + 3z = 12a$; wherefore resolving this cubic equation, *z* or the ordinate *CQ* will be known; now let the area *OPS* be divided into 100 parts, this area is the 12th part of the square of the *Latus rectum*, consequently, $12a =$ that square $= 4$; if therefore the roots of the equations $z^3 + 3z = 0, 04 : 0, 12 : 0, 16$, &c. be successively extracted, there will be found so many *z*, or ordinates *CQ* respectively; and the area *SOP* will be divided into 100 parts; and in the same manner the calculation may be continued beyond the place *O*; for the root of this equation, when *RQ* is $= 1$, is the tabular tangent of the angle *CRQ*, or of half the angle *CSP*, and consequently the angle *CSP* is given; and *RC* the secant of the same angle *CRQ*, is a mean proportional between *RQ* or 1, and *RT*, which is double *SC*, as is very well known from conics; if *SP* be put $= 1$, the *Latus rectum* will be 4 (as in Mr. *Halley's* table) and *RT* will be the distance sought, to wit, the double of *SC* in the former parabola; and after this manner Mr. *Halley* calculated the above table, serving to represent the motions of all comets; for none of them that have hitherto been observed, have deviated from the laws of the parabola.

Now

Now it remains to give the rules of the calculation, and to shew the method of computing the apparent place of a comet by these numbers; the velocity of a comet moving in a parabola, is always to the velocity of a planet revolving in a circle round the sun, at the same distance from the sun, as $\sqrt{2}$ to 1, as is plain from Sir Isaac Newton's *Princip. Philof. Natur. Mathem. Lib. I. Prop. 16. Corol. 7.* if therefore, a comet in its *Perihelium* be suppos'd to be at a distance equal to that of the earth from the sun, the diurnal area, which the comet would describe, will be to the area, which the earth describes, as $\sqrt{2}$ to 1; and consequently, the annual period would be to the time, wherein such a comet would describe a quadrant of its orbit from the *Perihelium*, as 3,14159, &c. (that is, as the area of the circle) to $\sqrt{3}$; therefore the comet would describe that quadrant in 109 d. 14 h. 46'; and consequently that parabolic area, analogous to the area POS, being divided into 100 parts, the parts corresponding to each day are 0,912280, whose logarithm 9,960128 is to be reserved for constant use; but the times, in which a comet would describe similar quadrants in a greater or less distance, are as the revolutions in circles; that is, in the sesquuplicate ratio of the distances; and consequently, the diurnal area's estimated in centesimal parts of a quadrant (which are put as the measures of the mean motion, like degrees) are in each in a subsequalteral ratio of the distance of the *Perihelium* from the sun.

These necessary things being premised, let it be proposed to compute the apparent place of any of our comets for any given time. 1. Let the sun's distance from the equinox, and the logarithm of its distance from the earth be known. 2. Let the interval of time, between the time of the *Perihelium* and the time given, be taken in days and decimal parts of a day; add to the logarithm of this number the constant logarithm 9,960128, and the arithmetical complement of the sesquialteral logarithm of the distance of the *Perihelium* from the sun; the sum will be the logarithm of the mean motion, which is to be sought for in the first column of the general table. 3. Let the angle from the *Perihelium*, corresponding with the mean motion be taken, as also the logarithm for the distance from the sun; and if the time be after the *Perihelium*, in direct comets, you must add, and in retrograde ones subtract; but if the time is before the *Perihelium*, in direct comets subtract, and in retrograde comets, add the angle so found to, or from the place of the *Perihelium*; and thus you have the place of the comet in its orbit; and to the

logarithm of the distance found in the table adding the logarithm of the distance of the *Perihelium*, the sum is the logarithm of the true distance of the comet from the sun. 4. Having the place of the node, together with that of the comet in its orbit, let the distance of the comet from the node be taken; and having the inclination of the plane, there shall also be given, from the known rules of trigonometry, the place of the comet reduced to the ecliptic, together with its inclination, or heliocentric latitude, and the logarithm of its curvate distance. 5. From these *Data*, by the very same rules, by which the places of the planets are found, from the given place and distance of the sun, we shall also find the apparent, or geocentric place, together with the apparent latitude; which is worth while to illustrate by an example or two.

Example I. To find the place of the Comet of the year 1664 March 1 d. 7 h. 00' P. M. at London; that is 96 d. 19 h. 8' after its Perihelium, which happened in November 24th 11 h. 52'

Log. dist. Perihel.	10.011044	Perihel. Δ	10.41.29
Log. sesquialt.	10.016566	Corresp. Ang.	83.38.95
Comp. Arith.	9.983434	Comet in orb δ	17.3.20
	9.960128	δ II	21.14.00
Log. time	1.985862	Comet from node	34.10.40
Log. mean Mot.	1.929424	Red. to Eclipt.	32.19.05
Mean Motion	85.001	Comet helioc. δ	18.54.55
		North. Incl.	11.46.50

Log. for dist. 0.255396

Log. Perihel. 0.011044

Co-sine Incl. 9.990754

Log. dist. curt. 0.257167

Log. of Sun's dist. 9.997918

$\odot \times$ 21.44.48

Appar. place of Comet $\vee$ 29.18.30

Appar. Lat. N. 8.36.15

Example II. To find the place of the Comet Anno 1682, July 23rd 13 h. 35' P. M. at London, or 13 h. 40' equated time, that is, 21 d. 10 h. 50' after the Perihelium

Log.

Log. dist. Perihel.	9.748343	Perihel. II	25	29	30
Log. sesquialt.	9.622514	Corresp. Ang.	56	47	20
Compl. Arith.	0.377486	Comet in orb γ	28	42	10
	9.960428	$\odot$ $\times$	23	23	00
Log. of time	1.310723	Com. from $\odot$	35	19	10
Log. mean Mot.	1.648337	Red. to Eclipt.	4	48	30
Mean motion	44 498	Comet helioc. $\times$	28	11	30
		North. Incl.	35	2	00

Log. for dist.	0.111336
Log. Perihel.	9.748343
Cofine Incl.	9.914387
Log. dist. curt.	9.772866
Log. $\odot$'s dist.	0.006104
$\odot$'s place α	10 41 25
Appar. place of Comet $\odot$	5 11 50
North Lat.	28 52 00

At the instant specified in the first example, it was observed by Dr. Hook at London, that the comet applied to the second star of *Aries*; so that it was found to be nine minutes more northerly, and three minutes more easterly than the said star: In the second example, Mr. Halley himself near London, found (with the same instruments wherewith he had formerly observed the stars of the southern hemisphere) the place of the comet at $5^{\circ} 11' \frac{1}{2}$ of $\odot$ with $28^{\circ} 52'$ N. Lat. the observation made at Greenwich almost at the same moment of time exactly agreeing therewith.

But the comet Anno 1680, which almost touched the sun (for in its *Perihelium* it was not the $\frac{1}{2}$ part of the diameter of the sun distant from its superficies) having its *Latus rectum* exceeding small, it could not by reason of the great velocity of the mean motion not be brought into the general table; therefore, in this comet it is the better way, after having found the mean motion, by the help of the preceeding equation $2^3 + 32 = 100$, of the mean motion, to find from the same the tangent of $\frac{1}{2}$ the angle from the *Perihelium*, together with the logarithm for the distance from the sun; which being given, you are to proceed by the very same rules as in the rest: It is to be observed, that the five first comets; the third and fourth of which was seen by *Petrus Apianus*, and the fifth by *Paulus Fabricius*, as was the tenth

10th by *Maslinus* in the year 1596, have not the same degree of certainty with the rest; the observations not having been made with the proper instruments or the necessary exactness; and therefore, disagreeing with each other, they can by no means be reconciled with a regular calculation; *Blanchini* alone observed at Rome the comet Anno 1684; and the astronomers at Paris the last comet in 1698, whose path they have described in an unusual manner; this very obscure comet tho' swift and pretty near the earth, escaped our observations: Mr. *Halley* forbore to insert into his catalogue the two remarkable comets that appeared, the one in November 1680, and the other in February 1702, for want of observations; for directing their course towards the southern parts of the world, and being scarcely visible in Europe, they were not observed by persons equal to the task: It is to be observed, that 11 of the comets in Mr. *Halley's* catalogue moved direct, *i. e.* according to the order of the signs, *viz.* those in the years 1532, 1556, 1580, 1585, 1618, 1652, 1661, 1672, 1680, 1584 and 1686; and that the other 13 were retrograde, *i. e.* moved contrary to the order of the signs.

Upon thoroughly weighing all these things, and comparing the rest of the elements of the motions of these comets with each other, it will appear, that their orbits are disposed in no certain order; and that they are not confined like the planets to the zodiac, but that they move indifferently, every way both retrograde and direct; whence it is plain, that they are not moved by *Vortices*; the distances of their *Perihelia* are found to be sometimes greater and sometimes less; whence we have reason to suspect, that there are a great many more comets, which being at remote distances from the sun, and being obscure and without a tail, may for that reason escape our observation.

We have hitherto considered the orbits of comets as perfectly parabolic, from which supposition it would follow, that comets, being impelled by a centripetal force towards the sun, do descend from infinite distances, and by their fall acquire so great a velocity, as to convey them into the remotest spaces of the system, and by a perpetual *Nisus* tending upwards, never afterwards to return again to the sun; seeing then that the appearing of comets is very frequent, and that none of them is found to move in an hyperbola, or with a greater velocity than it would acquire in falling towards the sun, it is more credible, that they revolve about the sun in very excentric orbits, and return after very long periods; for, thus their number is definise and perhaps not so very great; and the spaces between the sun and the fixed stars

are so immense, that there is room enough for a comet to perform its period, however large it may be; for the *Latus rectum* of an ellipsis is to the *Latus rectum* of a parabola, having the same *Perihelian* distance, as the *Aphelian* distance in the ellipsis is to its whole axis; but the velocities are in the subduplicate ratio of the same; wherefore, in very excentric orbits, this ratio approaches nearly to a ratio of equality, and the small difference, which arises on account of the greater velocity in a parabola, is very easily compensated in determining the situation of the orbit; therefore, the principal use of the elements of the motions in this table is, that whenever a new comet appears, we may by comparing the elements, know whether it is one of those that formerly appeared; and consequently, we may determine its period, and the axis of its orbit, and foretel its return; and Mr. *Halley* tells us that he had several reasons to induce him to believe, that the comet in 1531, which was observed by *Apian*, was the same with that described in 1607 by *Kepler* and *Longomontanus*, and which he himself had seen and observed upon its return again in 1682; all the elements agree, and there is no other difference than the inequality of their periods; which yet is not so considerable, as that it may not be ascribed to physical causes; for *Saturn's* motion is disturbed in such a manner by the other planets, especially *Jupiter*, that its periodical time is for some whole days uncertain; how much more may a comet be subject to such irregularities, whose orbit rises almost four times higher than *Saturn's*, and whose velocity, tho' never so little augmented, may change its orbit from an ellipsis to a parabola; that it was the same comet, is farther confirmed, from that observed in the summer of 1456, to pass retrograde, almost in the same manner, between the sun and the earth; which tho' it was not observed astronomically by any, yet Mr. *Halley* conjectures, that it was the same with the former, from its period and the manner of its transit; whence he ventures to foretel its return in 1758, and if this happens, there will be no further cause to doubt, but that the rest may likewise return; astronomers will therefore have a large field, to exercise themselves in for several ages, before they can determine the number of so many and so great bodies that revolve round the common center of the sun, and reduce their motions to certain rules: Mr. *Halley* was apt to believe, that the comet of 1532 was the same with that observed by *Hevelius* in the beginning of 1661; but *Apian's* observations, which are the only ones we have, are too inaccurate, to determine any thing certain from them in so nice an affair: Sir *Isaac Newton* delivers

a method of constructing the orbits of comets by three accurate observations, *Philos. Natural. Princip. Mathematic. lib. III.* which afterwards Dr. Gregory fully and clearly illustrated in the fifth book of his physical and geometrical astronomy.

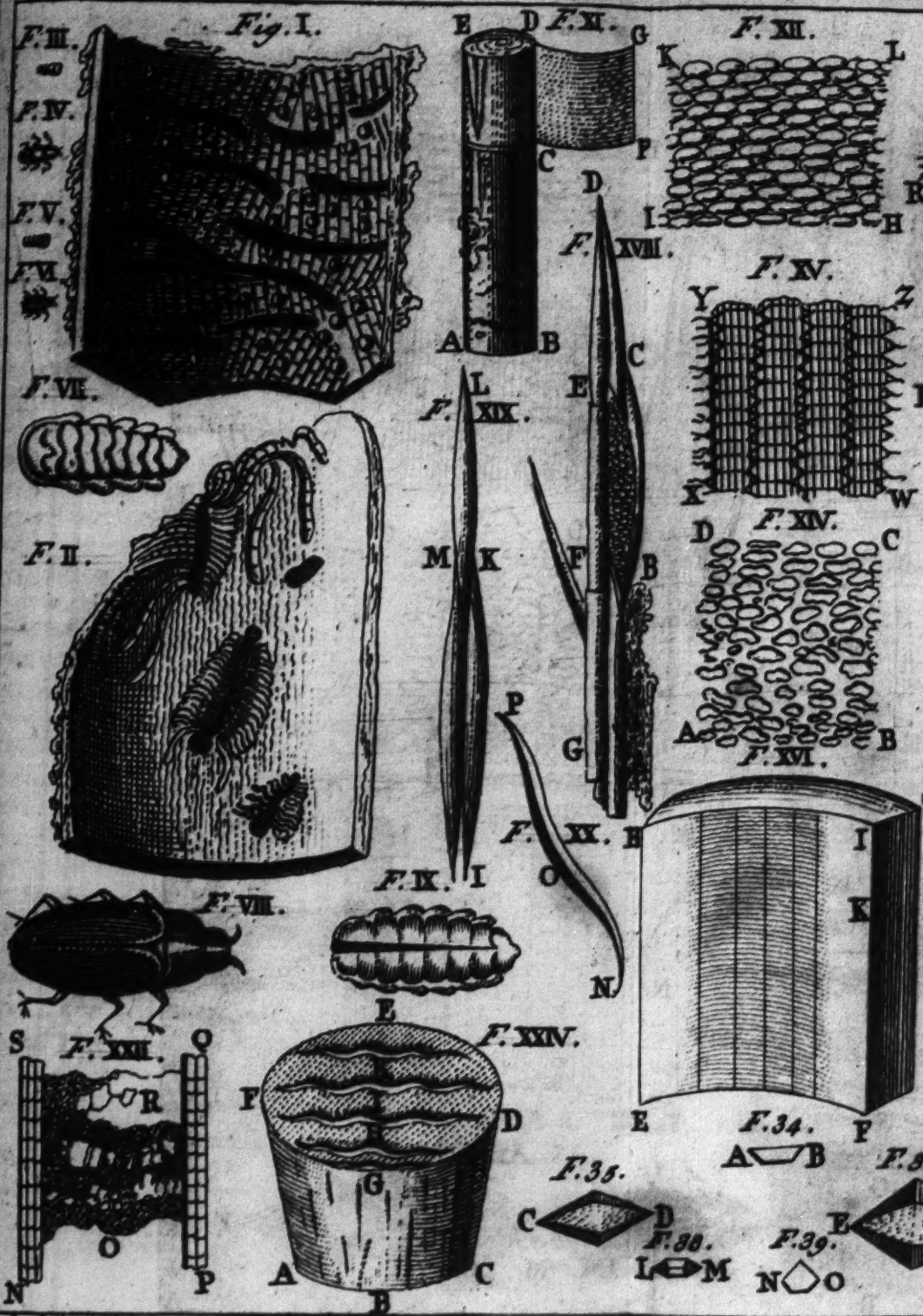
Here one thing is to be observed, *viz.* that some of these comets have their nodes so near the annual orbit of the earth, that should it happen at the time of the return of a comet, that the earth was near its node, whilst the comet passes with an incredible velocity, it would also have a very sensible parallax, and which would be to the sun's parallax in a given ratio; whence, upon such like transits, there will be a very favourable opportunity (which yet seldom happens) of determining the distance of the sun from the earth; which hitherto could be concluded but very loosely, and that only by means of the parallax of *Mars* in opposition to the sun, or that of *Venus* in her *Perigæum*; and tho' indeed it is thrice greater than the parallax of the sun, yet it is scarcely perceptible with any instrument; and this use of comets was suggested by the famous geometrician *Nic. Facio*; for the comet of the year 1472 had a parallax 20 times greater than that of the sun; and had the comet *Anno* 1618 arrived, about the middle of *March*, at its descending node, or had the comet *Anno* 1684 come a little sooner to its ascending node, being very near the earth they would have had still more sensible parallaxes; of all the comets there was none that approached nearer the earth than that *Anno* 1680; for, upon a calculation, it was no further distant towards the north from our annual orbit, than the sun's semidiameter (or the radius of the moon's orbit, as Mr. *Halley* supposes) and that too in *November* 10th 1 h. 6' *P. M.*; at which time had it been in conjunction with the earth as to longitude, there might have been observed in its motion a parallax equal to that of the moon: Mr. *Halley* leaves it to philosophers to discuss, what consequences would arise from the appulse, contact, or collision of the celestial bodies, which yet is not altogether impossible.

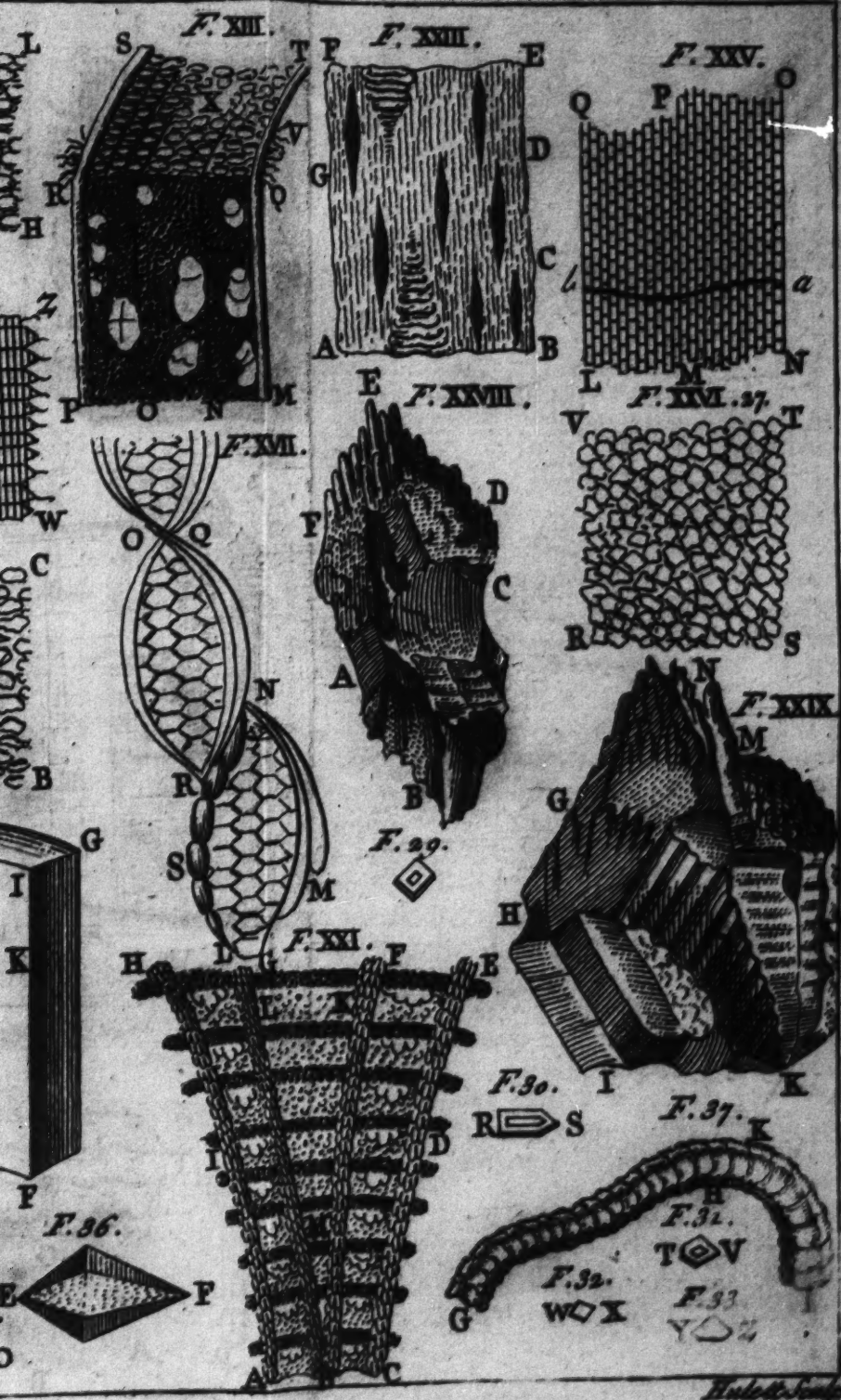
The Bark of Trees; by M. Leewenhoeck. Phil. Trans. N^o 297. p. 1898.

M. *Leewenhoeck* had for several years been convinced, as to his own particular, that the bark of trees is produced from the wood, and not the wood from the bark, as several have affirmed; for farther satisfaction about this matter, he had a piece of cinnamon-wood, about the bigness of a writing quill, which had its bark still on; he judged that this piece of cinna-

mon-wood would be the most proper to prove, that the bark is formed out of the wood, because, the horizontal vessels of that wood were of the same colour with the cinnamon itself; but how nicely soever he managed this wood, he could not cut it a-cross into pieces, so as to keep the bark and wood united, but the bark would always be separated from the wood; which he ascribes to the island of *Ceylon*, where this wood grows, being situated between the fifth and tenth degrees of northern latitude; so that the fruit, wood, and bark are of one year's growth, by which means new sap, and juices are always carried up between the wood and the bark, in order to form new ones; which is the reason, that the bark of cinnamon is so easily separated from the wood; wherefore, not finding his account in this experiment, M. *Leewenboeck* cut off a small twig of a cherry-tree, which is represented by ABCDE Plate XII. Fig. 11. in the wood of which, the canals or vessels of the bark, by which the same is nourished, are not extended lengthwise, but circularly about the wood; for which reason, the bark of the said wood cannot be stripped off lengthwise, but circularly, contrary to some other wood, as in the aforesaid figure, where a small piece of the bark as stripped off, is represented by CF DG; in which is to be observed, that the canals or vessels, whereof it consists, run from C to F, or from D to G: M. *Leewenboeck* asserted formerly, that in all countries where there is any winter, so far as to put a stop to the growth of trees, as long as the growth continues, the bark grows thicker, and the new bark protrudes that which was formed before, further and further from the wood; insomuch, that in the bark of old trees, one may cut a finger's breadth in depth, before he can come at any thing like greenness, or sap; and by carefully considering that bark, one may discover what part thereof is from time to time deprived of its nourishment, and consequently, what part of it is quite dead: By these his last observations, M. *Leewenboeck* discovered in a twig of a cherry-tree of a year's growth, that the bark consists at least of six thin membranes, whose exceeding thin vessels or fibres extended themselves circularly round the wood, and those membranes were very closely united to each other.

Fig. 12. HIKL represents one of these membranes, placed before the microscope, after having been so separated, as nicely as possible, from the rest; where may be observed, that the vessels or canals do not run lengthwise, but circularly round the wood; for which reason, the said vessels cannot long remain entire, but must from time to time be broken in pieces; when he
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cut a-cross the wood of a cherry-tree, which was about a year old, in order to shew the horizontal vessels derived from the wood to the bark; and by which the bark receives its growth and nourishment, the bark, by reason of the softness and flexibility of those parts that lay next the wood, did always yield so much, that it was impossible to delineate the said vessels: Upon this *M. Leewenboeck* was led to consider beech-wood, because, the greatest part of that wood is covered with a red bark, which sticks close to the wood, and grows yearly thicker; and upon the outside of that bark there is a whitish sort of bark often produced in a year, which falls off from the wood, as if it was peeled; but this only happens in beech-wood of an ordinary thickness; whereas, in the thickest wood this peeling or scaly sort of bark is not produced, whereby the bark grows exceeding thick, and the most part of it remains, as it were, without nourishment.

Fig. 13. MNOPQR, represents a small particle of the last mentioned wood, cut a-cross, after having been steeped in water, wherein are plainly to be seen the ascending vessels or canals, both great and small, between which run the horizontal vessels, which receive their juices from the ascending ones; after several cuts made with a sharp knife, he found the bark of the wood to be exceeding hard, which was mostly occasioned, as he imagined, by a coagulated whitish matter, which a person would take for rosin; the hardness of which hindered him from cutting the wood and bark so easily together, as not to hurt the horizontal vessels, which were continued from the wood to the bark in a right line; QUTSR represents, as it appeared before a microscope, a particle of the above-mentioned bark, in which the horizontal vessels, as they lie in the wood, and are continued on to the bark, and from whence the bark is produced, are shewn by NMOP, whereof N and O do not go quite through the bark, by reason of the hard substance before-mentioned, and which is to be seen in X; but the horizontal vessels, represented by MRS and PQUT, go throughout the wood, so far into the bark, as to preserve it from any mortification: Now, as the bark of the beech-tree, or rather its vessels or canals, run circularly round the wood, *M. Leewenboeck* could not at first conceive, how those canals could be produced out of the horizontal vessels; but at last he discovered, that as the horizontal vessels are continued from the wood, and carried on into part of the bark, represented by QUT, and shew between Q and U a few of those vessels which arise out of the said horizontal ones, and run circularly about the bark; and how nicely soever he observed them, he
could

could not discover one ascending canal; which must needs run lengthwise up the bark, in case the said bark had its rise from the root of the tree.

Fig. 14. A B C D. also represents a thin scaly particle of the bark of the said wood, as it appeared before the microscope, the vessels or canals of which likewise run horizontally from A to B, or from C to D; here observe, that this and the preceeding small particles of bark, are not so open as they are represented, but that only the vessels which run circularly about the wood are delineated, which at first lay close to each other, but as the wood grew larger, they were more and more separated from each other.

Fig. 15. W X Y Z. also shews a little scale of the bark of the twig of a tree, wherein the vessels represented by W X or Z Y, run circularly round the wood.

M. *Leewenboeck* had by him a piece of cinnamon-bark, brought from *Candy*, in the island of *Ceylon*, which was near eight inches long; a small part of which is represented by E F G H. Fig. 16. M. *Leewenboeck* judged by the divisions, which he observed between I and G, and which was the thickness of the bark, that the cinnamon-tree to which it belonged, was near 12 years old; and that the tree was about 6 inches diameter; he examin'd several times the outside of this bark, and always found that it was so brittle, as if it were partly corrupted, and upon cracking those brittle particles between his teeth, he could perceive no taste of cinnamon therein, so that he was obliged to pare away $\frac{2}{3}$ parts of the outside of the bark, before he could come to the strong and true taste of the cinnamon: Having moreover, enquir'd into that part of the bark that lies nearest, and joined as it were to the wood, and cutting it to pieces, he was further satisfied, that the cinnamon, otherwise called the bark, receives both its nourishment and increase from the wood only, and not from the root; for upon dividing this bark into small parts, he could discover no ascending vessels therein; but *é contra*, so many horizontal vessels proceeding from the wood, and those likewise so large, that he never discovered so many in the bark of any other trees.

Fig. 17. L M N O P Q R S. represents a very small particle of cinnamon-bark, wherein the horizontal vessels lie by each other in such order, as is shewn between L M N R S, or between N O Q R, in which they are all cut a-cross; several of these horizontal vessels are filled with a reddish matter, which in some vessels is not so high coloured as in others, some of them being almost yellow; these horizontal vessels are represented as they appeared, hexangu-

lar as it were, which is the most perfect figure nature could bestow on them, in order to prevent any interstices or vacuities between them: We may also see, that about the said horizontal vessels, there lie together longish parricles (represented by LMN, and some of them are larger than others) that run into a point at both extremities; and the said parts do also surround the horizontal vessels; moreover, these particles often contain in them a matter of different colours, which are entirely separated from each other, and appears as in NRS, and where no colours are to be perceived in the said figures, there they are transparent: M. *Leeuwenhoek* supposes, that these long transparent parts, as also those that are coloured, together with the horizontal vessels, which are almost all of them filled with a coloured matter, are the sole ingredients of the above-mentioned bark, or cinnamon; OPQ in the said figure represents but a part of the horizontal vessels, that lie by each other: All the said long particles, which in a great measure compose the cinnamon-bark, are not incurvated as in the last figure; but a great many of them are extended in right-lines, as in ABCDEFG. Fig. 18. which represents a very small particle of the above-mentioned long parts, and which likewise incloses some horizontal vessels; and wherein you may see at A how regularly the sharp points are ranged by each other; as also between BF and CE, between which the horizontal vessels are to be seen in that order, wherein they always lie; that sharp and pointed particle represented by FH, seems to be out of its place; and he supposes, that in dividing it from the other parts, he might have broke it off at F; he also placed three other long sharp pointed particles, before his microscope, as in IKL M. Fig. 19. in which also may be seen, in how regular an order they appear, as at KM; from whence we may conclude, that all the other parts of the like nature, are disposed in the same manner.

Fig. 20. NOP represents another pointed particle, exceedingly incurvated, which he supposes, might be occasioned by its having surrounded two several divisions of the horizontal vessels: We can pretty easily conceive, how one canal is produced or issues out from another, but how the said long sharp pointed particles, represented by Fig. 17. 18. 19. 20. are produced, as well as a great many other phenomena, he cannot account for: Moreover, M. *Leeuwenhoek* examined into the nature of the bark of a thick lime-tree, and the rather because, he knows no other bark, whose parts are so easily separated from each other, either in length or breadth; insomuch, that in *Muscovy* they make mats for packing and ropework

work thereof, which is very strong; and tho' it should lie long wet, it is not easily subject to rot.

Fig. 21. A B C D E F G H I. represents a small particle of the bark of a lime-tree, as it was cut a-cross; where, by A B C are shewn the horizontal vessels that arise from the wood, which consequently are cut lengthwise; tho' these vessels at their first issuing out of the wood lie close to each other, as from A to B, and from B to C; yet they do not always continue so close, but as the tree grows thicker and larger, the horizontal vessels are separated the more from each other; as for instance, that which at B is but one bundle or collection of vessels, with the increase of the tree, it divides itself into two, and the separation becomes larger and larger, as in B M K and B M L; now, that there may be no interstice or vacuity between the said horizontal vessels, there are other vessels that proceed from those, as may be seen between M I D, which new vessels yield a matter that fills the place of M L K; these parts are roundish, but so interlinked with each other, that they serve for canals; besides, they are represented larger than they appeared to be: These horizontal vessels do not run thro' the whole thickness of the old bark; for in some places the bark dies sooner than in others for want of nourishment; insomuch, that you may perceive in the bark of a lime-tree of an ordinary thickness, three distinct crusts lying on each other, the outermost of which being destitute of nourishment, by little and little it becomes dry and withers: M. *Leeuwenhoeck* cannot think that the great number of descending vessels discovered in the bark of the lime-tree, can proceed from the root of the said tree, but depend on the horizontal vessels of the same, which, by reason of their exceeding smallness are hardly visible in the last figure; for if the nourishment of the bark proceeds from the roots, the bark would never decay, unless the tree did so likewise; whereas, we see, that in some trees the greatest part of the bark is dead or withered:

Fig. 22. N O P Q R S represents a very small particle of the bark of a lime-tree, as it appeared before a larger microscope; wherein are shewn some of the orifices of the canals, that lie lengthwise in the bark, and are here cut a-cross, chiefly to give a view of the horizontal canals, as they are cut lengthwise, at N S or P Q, which are represented in Fig. 21. by A I H, B L M G, B M K P and C D E; these canals shewn by N S or P Q are not of a continued hollowness throughout, but rather seem to consist of oval particles linked to each other; so that he was apt

to

to think that each of the aforesaid oval particles were provided with a valve, which valves make them appear like so many oval figures; the use of which valves might be to hinder the juice or sap, which is raised up into those parts by the heat of the sun, from falling down or descending after sun set; especially, if we consider, that there must be caused so strong a promusion by the said canals in spring-time, as not only to separate the bark from the wood, but also to burst the outermost parts of the bark, that are already hard, dry and withered: M. *Leewenboock* said before, that the horizontal vessels or canals in cinnamon are hexangular, which is the most perfect figure, and takes up the least room; from whence he also concludes, that the horizontal vessels in Fig. 22. are hexangular, tho' he did not see them lie in the same order; for when he examined into the horizontal vessels or canals of the cinnamon, he found, that they were of the same configuration, as in NS, and PQ, Fig. 22. viz. that they consisted of oval figures.

Fig. 23. ABCDEFG represents, as it appeared before the microscope, a little slice of the lime-tree wood cut off lengthwise, in which may be reckoned in nine several places, the horizontal vessels or canals that are cut across, situated between the small ascending vessels, that for the most part nourish the wood; and those horizontal canals are also continued into the bark, so far as it is alive, and serve for its increase and nourishment. Now, there is no difference between the horizontal vessels in the wood and in the bark, but in the ascending vessels and the bark there is a difference; for they are of a like disposition with the horizontal vessels in the wood and in the bark; and so they agree with those as represented by NS or PQ in Fig. 22. Now, if we find, that the horizontal canals both in the wood and bark, are of a like contexture; and that the ascending vessels in the bark of a lime-tree are so likewise, we may hence more certainly conclude, that the bark is produced from the wood, and not from the root.

M. *Leewenboock* was again led to consider cork, which is said to grow as the bark of a tree, upon a certain sort of oak in Spain; which if it be so, he supposes, that the burning which we perceive in the leaves is done by two hot iron plates, in order to make it flat and streight; he then took one of those pieces of cork which are cut into stoppers for bottles, as represented by ABCDEF. Fig. 24; here you must suppose, that BG is the part that lay next the tree, and that E was the outside of the same; in the said piece of cork, between GHKE, he observ'd

five distinct divisions, running a-cross from F to D, the part that surrounded the tree; from whence he concludes, that the cork was arrived to such a thickness in five years time, for each streak or division denotes the growth of that year; he also observed, four distinct dark streaks, of which G I is the middlemost; he supposed they had been great canals, but he could not conceive for what end they were formed; only he concluded from thence, that in case these great canals had not been cut thro' in that manner lengthwise, the cork would not have been so thick; we must likewise conclude, that the length of all corks (in order to prevent either moisture or air from passing thro' them) must correspond to the length of the cork as it grows upon the tree; so that that part of the cork represented by A B C was the lowermost, and D E F G was the uppermost, or near the uppermost part, according to its situation upon the tree; now, for further satisfaction, he cut a little piece of cork, as from G to H, where you may suppose, that it was joined to the tree; and having placed the said piece before a microscope, he perceived, that all the canals were placed in the same manner as if they issued out from the wood, without discovering in the least any ascending vessels, tho' he cut it never so often; from whence he again concludes, that the growth of the cork proceeded from the wood.

Fig. 25. L M N *ab* O P Q shews a small particle of cork, as it was cut off between G and H, of which let us suppose L M N to be the part next the tree; and so the vessels or canals, by which it receives its increase, run horizontally, as from L to Q, from M to P, and from N to O; but he could not find one single canal that was perpendicular, or can be said to proceed from the root; these before-mentioned canals have no passage thorough, and it seems to M. *Leeuwenhoeck*, that there are so many valves in each canal, as there are horizontal vessels therein; by *ab* in the above Fig. is represented a line running quite a-cross, and somewhat incurvated, which is that part of the cork, where the season of the year being over, a stop was put to the growth thereof; for further satisfaction, he cut another piece of cork represented by R S T V. Fig. 26. as it appeared thro' a greater magnifier than that made use of in Fig. 25; this piece of cork was cut off from Fig. 24. between B and G, and was that part which was nearest, or united to the tree, and from whence it received its increase; so that consequently those horizontal canals which in Fig. 25. were cut lengthwise, were here cut a-cross; in Fig. 27. it may be perceived, that almost all those parts that were cut a-cross, did not consist of round canals, but of hexangular ones,

ones, which is agreeable to the most perfect order, because it prevents all intermediate vacuities; and M. *Leeuwenhoeck* supposes, that in case one could procure a piece of cork, before it had been made streight and flat, after the aforesaid manner, we should see the canals cut a-cross, as in Fig. 27. between RSTU more plainly than we now do; whereas, by the making it strait, a great many canals are displaced and disordered; as also by cutting it with a knife the exceeding fine membranes whereof the canals are composed, are often torn or broken to pieces.

Horn-like Excrescencies growing on the Fingers, &c. by Dr. Richard Wroe. Phil. Transf. N^o 297. p. 1899.

THE RE lived at Bolton, eight miles from Manchester, one *Nathaniel Hulme*, aged about 17, who had the small-pox about eight years of age; soon after which, he had a stubborn itch, almost to the degree of a leprosy, with which his fingers and thumb-nails began to grow thick, and by degrees to harden into horns; which grew in seven or eight months an inch long, some almost two inches, and others much longer; it began in the fore-finger of his left-hand, and so came to all the rest of that hand, which had as many horns as fingers and thumb; all which horns in about a twelvemonth fell off by degrees; that which grew first falling off first, without any pain, unless when cut off, as they were at the beginning; there appearing large quicks, as they are called, or roots under the nails; by degrees they came on the thumb, and then on the fingers of the right-hand, which grew to the same length with the former, in about a year's time, and then fell off, he having shed them five or six several times; one of the horns that grew on the ring-finger of the left-hand, was a quarter long; after they had all come off his left-hand, they began to grow again; that on his little finger was two inches long; and the Dr. had one or two of them by him; about two years afterwards the Dr. saw him frequently, when the horns still continued to grow and fall off as usual; he had horns on every toe, but he kept them cut, that he might be able to wear shoes; and he was so overspread with the leprosy, that the Dr. thought he could not live long.

Some Swedish Coins, and a Calculation for finding Easter; by Mr. Ralph Thoresby. Phil. Transf. N^o 297. p. 1901.

MR. *Thoresby* had a Swedish coin, or rather square copper-plate, nine inches broad, and nine and a half long, which was much like the Roman *A's* grave, and was current A 1679,

tho' now they are not to be met with; it had at each corner the impression of a crown, under which is the year, and round it this inscription CAROLUS XI. D. G. SVE. GOT. WAN. REX; and in the middle of the plate in a circle a DALER. SÖH Mijt; the other side of the plate has no inscription.

Richard Thornton Esq. made the following calculation for finding Easter.

Rightly to understand the Rule in our Common Prayer Books for finding Easter.

Observe 1. That the 21st of *March* in all but leap-years, and in leap-years the 20th of *March*, was at the time of the council of *Nice*, when this rule was made, the vernal equinox; consequently; 2. That the 20th of *March* in leap-years, is the same as the 21st of *March* in common years. 3. That the full moon meant in this rule is not to be found in our almanacks, but by the kalender of our common-prayer book; where in the first column, the golden number of every year is placed over against the day of the new moon, in every month of the year. 4. That the 14th day, including the 1st day of the moon, is the full moon, and not the 15th, as *Dr. Wallis* would have it in *Phil. Trans.* N° 140.

An Experiment on the Propagation of Sound in condensed Air; together with a Repetition of the same in an open Field; and of the Diminution of Sound in rarified Air; by Mr. Francis Hauksbee. Phil. Trans. N° 297. p. 1902.

UPON including a bell in a brass recipient, and placing it at one end of a room, about 50 yards in length, at the other end of which stood some gentlemen to observe the sound; before any air was intruded, the bell, upon shaking, was heard at that distance, tho' not without diligent attention; upon the intrusion of one atmosphere, or quantity of air, the bell being shaken as before, the sound was very sensibly augmented; two atmospheres being impelled and the bell made to ring, a notable improvement of the sound was then manifest; but upon the intrusion of the third, fourth and fifth atmospheres, the bell being made to strike, the sound seemed not to be propagated proportionably to the first and second; which might happen by means of some escapes of air, the valve which should have hindered the return of the injected air, not holding so tight as it ought, but that some of the intruded air repassed into the syringe; by which means the quantities supposed to be injected were deficient; another

another reason why, the latter atmospheres did not propagate the sound as the two first had done, is this; tho' 25 compressions of the syringe are equal to the natural contents of the recipient, yet, when the air becomes pretty strongly condensed, as by the intrusion of four or five atmospheres, the remaining air at every stroke, which will lie between the bottom of the *Embolus* and the valve (tho' but little) is at the same density in the same time, as the air in the recipient; which upon drawing up the forcer, will extend itself to supply such a space of the cylinder, as so much common air; and is so much short of what should be injected at every stroke, 25 of which become equal to the natural contents of the receiver; hence, the deficiencies of the real atmospheres, or quantities by a certain number of strokes, may be very considerable, and it may be very difficult to account for them: Notwithstanding the deficiencies are not known, (yet at the end of the five, tho' imperfect) atmospheres, the bell being shaken as at first, it was the opinion of a gentleman then 50 yards distant, that the sound seemed to be almost as sensible, as when it came to be made and exposed in the open air.

June the 9th about five in the morning, Mr. *Hauksbee* repeated this experiment in an open field, called *white Conduit*, situated to the west of *Islington*, with much the same success as the former; upon shaking the bell, before any air was intruded, it was but just audible at 30 yards distance; upon the injection of one atmosphere, it became then as audible at 60 yards, as it was before at 30; a second being intruded, the bell upon shaking, might then be heard at 90 yards distance; but after that, tho' near 100 strokes of the forcer were repeated, yet it could hardly be heard 20 yards farther; which Mr. *Hauksbee* attributed to the reasons before given; the morning was very misty, which caused a great dew upon the grass; there was little or no wind stirring; and the silence, requisite in making such an experiment nicely, at last began to be interrupted by the noise of the five o'clock bells and other noises that joined with them from *London*, contributing in some measure to the unsuccessfulness of the latter part of the experiment.

A bell being included under a receiver, and shaken, to make the clapper strike, it was very observable, that the interposition of the glass betwixt the bell and the ear, was a great obstruction to its sound, notwithstanding, it was audible at some good distance from it; but upon gradually exhausting the air, and making several stops to shake the bell at different degrees of rarefaction, the diminution of the sound at every stop was very distinguishable;

able; till at last, when the receiver was well exhausted of air, the remains of sound were then so little, that the best ears could but just distinguish it; it seeming to them like a small shrill sound at a great distance; upon permitting the air to re-enter, not all at once, but by degrees, it was easy to perceive the increase of sound, at the different times the bell was made to ring; the recipient being again replete with air, the sound seemed then somewhat more clear, and audible, than it did upon its being first included.

The Figures of the Salts of Chrystal; by M. Leewenhoeck.
Phil. Trans. N° 298. p. 1906.

M. *Valkenier* shewed M. *Leewenhoeck* crystals, amongst several, one remarkable, as big as his fist, which looked like so many small flints joined together; they seemed to be united by very transparent particles, which might be called wild crystal; and upon viewing the said crystalline particles, the largest prominent points of which seemed no bigger thro' the microscope than a coarse grain of sand, several of them appeared to M. *Leewenhoeck* to be hexangular, like mountain-crystal: M. *Valkenier* farther told him, that in some of the highest mountains of *Switzerland*, the large and small stones were almost mixed, or united with the wild crystal; which mountains are therefore called by the natives *Nagelfelsen*, i. e. the nail mountains or rocks, by reason of the great number of prominent points therein: M. *Leewenhoeck* struck off four or five small flints from one of these stones, whereupon several of the said wild crystal particles came off together; which he placed before a microscope, and observed that each of them was almost of a different figure, tho' most of them run into an hexangular point of several sizes; in breaking them from each other, the sides assumed particular figures, which appeared as if they were composed of nothing but long particles, all as bright and transparent as any crystal, excepting only in those parts where they were joined to the stones; the crystal particles lay very close upon each other, and were so small, that upwards of 100 of them were not equal to one of our crystal particles; amongst others, he observed some, no bigger than a coarse grain of sand, which consisted of 100 other smaller particles, all very transparent, and appearing thro' the glass like a little mountain of crystal, which was a very agreeable sight; he likewise observed several crystal particles, which instead of terminating in one hexangular point like others, consisted of several sharp ones, some of which were very different both in length and

and thickness from the rest, which confirmed him in his opinion, that they were coagulated out of long particles; he observed, that where the little flints did not lie very close to each other, the void space, as it appeared to the naked eye, was also filled with the said chrystalline matter; but when he came to view them more narrowly, he could perceive that those chrystalline parts were indeed united to the little flints, but that there were several small cavities between them; from whence he concluded, that the flints lying so upon each other, as we now find them, a fluid chrystalline matter, out of which all the crystals were coagulated, had insinuated itself between them; and where they were not so closely joined, there did not happen to be enough of that chrystalline matter to fill up the vacant space.

Plate XII. Fig. 28. ABCDEF represents, as it appeared thro' a microscope, one of the said crystal particles; wherein may be observed at ABC, and partly also between DF, how it had been joined, and how it had also been broken off from other chrystalline particles; between DEF is that part, from whence proceed several prominent points.

Fig. 29. GHIKLMN represents a larger particle of crystal, which had been joined to another that lay by it; in GHIKO is shewn that part which had not been united, and in which, as far as it is possible, the several prominent points are represented by LMNGO; he found that these aforesaid chrystalline particles were easily separable; to make a further trial of their softness, he placed a particle thereof no bigger than a grain of sand upon a plate, and then pressing it with his thumb-nail, it broke into 1000 little pieces; which seemed the more surprising to him, because it is generally known, how hard mountain crystal is: From this experiment, M. *Leeuwenhoeck* supposed, that what we call wild crystal is mostly salt, if perhaps, it be not all so; to make a further trial thereof, he took about the bigness of a pea of the said crystal, which he had broke off from a flint, and laying it upon a silver smith's wood coal, he put it into a glowing heat, and then throwing it into some pure rain-water, it was immediately dissolved into white powder; but viewing the same with his microscope, he saw that there still remained some particles as big as a grain of sand; the small quantity of water, wherein the crystal lay, having stood about $\frac{1}{4}$ of an hour, he observed that its surface was covered with a thin scum, of which taking a little (as he again did when the scum was grown thicker, after the space of three or four hours) and placing it before a microscope, he observed, that besides several small particles, whereof the

the scum for the most part consisted, there lay a vast number of salt particles, of very different figures; some of them were long, others quadrangular and others again of hexangular figures, and all of them appeared to be solid cubical bodies; their longest sides were parallel to each other; and when he viewed these coagulated salts, some of which lay upon the surface of the water, as others had subsided to the bottom, he observed that they were not only grown larger, but that each of them was encompassed with several circles: Moreover, where the water was exhaled, there lay such a vast number of small salt particles, that they escaped in a manner the sight; insomuch, that it was impossible to discover any figure; and in some, that were still smaller, there was nothing more to be seen, but an exceeding slenderness and length, just as very small particles or threads of wool appear to the naked eye; from which observation, he supposed, that in case he had put the water a little thicker together, instead of spreading it upon the glass as thin as it was possible, the coagulation of the saline particles would have been thicker and larger; he also concluded, that most of those very slender and long particles were of the same figure with the larger ones; when a great many of those very transparent, and as it were crystalline salt particles were become dry, their transparency did in a manner vanish, and they became opaque bodies; in which a person could not perceive the least transparency, they appearing to be a white matter: This discovery made M. *Laewenboeck* imagine, that whereas, one of those aforesaid particles, whilst it had any moisture about it, was always increasing, by a confluence or coagulation of vastly small salt particles, all so firmly united to each other, that they seemed to be so many crystals; so when that some moisture was entirely exhaled, the coagulated particles were presently separated from each other; yet the solution was not so efficacious as to deprive them of the figure they had, but only to dissolve their conjunction; so that instead of being one transparent body, they became several bodies, that did not admit the light, but appeared white to the eye; and he likewise supposed, that when the water was exhaled at last, those very small salt particles, whose figures by reason of their smallness, had altogether escaped his sight, were not coagulated upon the large saline particles, and so deprived them of their transparency; whereas the salt particles, that were more thinly coagulated, preserved their transparency, but these were but very few: After that the abovementioned water had stood several days upon the wild crystal, which had been thrown into it glowing hot, he put a very small

small piece thereof upon a clean glass, and placing the water so as that there came but very little air to it, he then could perceive but a very little coagulation of the salt particles; but upon placing the same water in the air, he saw that a great many salt particles were coagulated; in short, there was almost an incredible number of exceeding small particles in a little quantity of water that lay within the compass of a single pea: Moreover, M. *Leeuwenboeck* taking some of the salt particles that lay upon the surface of the water, after it had stood about eight days, he observed at the same time, that they were not only coagulated into larger masses, with very neat, smooth sides and superficies, but that they were also become much thicker, as well as broader and longer, that they appeared to be solid cubical bodies of crystal; yet he could not discover, in a great number of those salt particles, any two that were similar: Now upon finding that the wild crystal, after having been heated glowing hot, had dissolved itself into such a vast number of small particles in the water, he took a small copper porringer, whose cavity formed half a globe, and having cleaned it very well, he put a little of the said crystal into a small quantity of water, and placing it over a wood coal, it boiled in the space of a minute, and he kept it there till the water had almost evaporated; after which he mixed the remainder with rain-water, and put some of the same upon several clean glasses, in order to see whether the water, by the above-mentioned boiling, was not also impregnated with salt particles: This water being mostly exhaled, he discovered therein several salt particles, almost of the same figure with the former; but forasmuch, as the water wherein the wild crystal had been put glowing hot, was entirely exhaled, the last glasses were altogether covered with a vapour, which mostly surrounded the salt particles, which he supposed to be very soft, and they were also covered with a very thin membrane: To be further satisfied about the last observation, M. *Leeuwenboeck* heated the glass whereon the last salt particles lay, till the vapour or moisture was quite exhaled, and then he could perceive a great many small salts, that he had not seen before, but nothing near so many as were in the first water; after the space of about an hour, it being moist weather, when he viewed the glass again, he found that the waterish vapour lay so thick about the salts, as if none had been exhaled.

Fig. 29. represents between P and Q a small salt particle, wherein lay another, that according to all appearance, was at first

coagulated, and afterwards arrived at that bigness, when the water was quite evaporated.

Fig. 30. represents between R and S another salt, having also within it a coagulated particle, which has at R two right angles, and at S an acute one, both the long sides thereof running parallel, and at equal distances from each other, and there were a great many of that figure.

Fig. 31. TU represents an hexangular salt particle, wherein also lay a smaller one of the same shape, and which was very thick.

Fig. 32. represents between W and X, a salt particle, whose superficies formed an exact square; he met with very few of such figures, especially where the water had lain thick.

Fig. 33. YZ. represents a particle, of which he discovered an exceeding great number, tho' they were very thin.

Fig. 34. shews between A and B another salt particle, whereof there was a vast number coagulated in the water: After M. *Leewenhoeck* had made a great many experiments in the last-mentioned water, till it was quite exhale'd; and having also poured fresh water twice upon the said wild crystal, he was surpris'd to see, that each time there was a coagulation of new salts upon the surface of the water; but most of them were so very small, that they appeared thro' the microscope no bigger than a grain of sand to the naked eye; yet he could very plainly perceive their figures, and the more, because they were all very transparent; and whereas, a great many salt particles are so soft, that in moist weather they are dissolved into a watry vapour, these were so hard and likewise so dry, as if they had been salts of chalk; and upon shaking the glass wherein they were, they came off from it, especially such as were pretty large: After these observations, he again view'd with a microscope, several pieces of rock crystal, as broken off from the stone, wherein he had formerly discovered amongst other figures, such as are represented in Fig. 31. between TU; and now observing an hexangular piece of crystal, which also terminated in a point of the like shape, he discovered therein several small pointed blue crystals, as in Fig. 53. between C and D; they were of several sizes, and some of them were of a finer blue than the rest; he also discovered in another piece of crystal much the same figure, but none of them were blue, some of which were as transparent as crystals, and others again as dark, as if it had been nothing but a blackish earth; and some of them lay much deeper in the crystal than others; he

he had one piece of crystal, wherein he reckoned upwards of 30 little blue figures, such as are represented in the last figure; and some of them were so very small, that they appeared no larger thro' a microscope, than a grain of coarse sand to the naked eye; and as far as he could judge of them, they were mostly hexangular; but he observed, that some of them were not so perfect and regular as the rest, having one point larger than the others, as represented in Fig. 36. between EF; he also observed a little figure, that was exactly of equal sides, only, that its fore-sides ran obliquely, and its superficies also consisted of an exact quadrilateral figure; it was moreover, as bright as crystal, appearing just like one of those common diamonds, called thick stones; yet it is very surprising to see the above-mentioned figures incorporated in such a hard substance; some lying near the superficies of the chystal, and others much deeper: M. *Leewenhoeck* had a piece of rock crystal about a finger thick and an inch long, that was hexangular, and terminated in an hexangular point; upon one side could be discovered with the naked eye, little cavities or holes, about the bigness of half a nail, which seemed for the most part, to be filled with an earthy matter; but when he placed the said crystal before his microscope, his opinion of it was, that whilst it was growing, or coagulating, several little insects running upon it, were intangled or imprisoned therein; the rather, because some other particles lay still deeper in the crystal, and so were altogether shut up in it; the bodies of these insects or worms consisted of very small and slender circles, or annular particles, as M. *Leewenhoeck* frequently observed in in such *Animalcula*.

Fig. 37. GHIK. represents, as it appeared thro' a microscope, a small part of one of these seeming insects, that lay pretty deep in the crystal; he could see this part no further, because its extremities G and I were covered with other such like particles; and this also was the largest he could discover amongst them; for the other particles were broken into much smaller pieces; amongst all he observed, there was but one particle that terminated in a point, and that he judged to be a part of the tail, as he supposed another had been the head; he also saw two small particles that were equally green, as were several other little pieces of insects: He had two pieces of crystal, of which the smallest was above an inch thick, and hexangular, wherein he discovered seven long particles, the largest of which was no thicker than a hair of the head; they were

of a dark grey colour, and had at one extremity several thinner particles, or small fibres branching out; some others were much finer than a single hair, and some were of an exceeding fineness: In another thicker crystal, he saw above 25 more such like particles, and tho' he broke that crystal into pieces, in order to discover what matter these particles were composed of, yet he could not succeed therein; he indeed saw, that one of them had a sort of cavity, and was round; another flat, without any cavity; and he could perceive, in another piece of the broken crystal a triangular long particle, that was hollow; this last was very invisible, because one extremity thereof lay opposed to his sight; he also saw another very plainly that was triangular, two of whose sides were a third part broader than the other; but he could not be positive, whether it was hollow or not; he also saw another long particle that was quadrilateral, whose two opposite sides were twice as broad as the other two; and forasmuch as he was well assured, that it could never have been any hair, or particles of wool; and as he had never seen any vegetable, that produced such fine slender parts, he could not conclude, what sort of substance it was, and much less, how they could come into the crystal, wherein they lay a-cross or athwart each other.

M. *Leewenboeck* observed before, that when he placed such rock crystal over the fire, it burst into a great many pieces; from whence he inferred, that therein must be shut up either some vapour, or else particles of salt, that occasion'd its breaking into so many pieces; to discover which, he put into a little glass, several such broken bits of crystal, and he observed, that a very little quantity of moisture and salt was extracted therefrom by the fire; but when he dropped into water some of those pieces of crystal, as glowing hot as he could make them, he could not discover, as he had done in others, any salt particles coagulated upon the surface of the water; however, he took a few more pieces of crystal, and placing them upon a wood coal, he dropped into some clean rain-water, the small remainder which had not been sublimed by the heat; and tho' he could discover no salt particles upon the surface thereof, yet several times he took some of the said water, and poured it upon very clean glasses; and after it had stood some time, both in moist and dry weather, he viewed it often, and always perceived that there lay a great many coagulated salt particles of different figures, but he could not discover the exact figure of most of them, because the water had not exhaled; yet he sup-

posed

posed, that there were salts of two kinds therein, viz. the salts that were already coagulated, and other salts that surrounded these; he viewed these salt particles in the afternoon, and in clear weather, in the month of *April*; and next morning about 6 o'clock; he perceived, that they were surrounded with so many seeming watry particles, as made it a surprising sight; when he had a very clear view of the said salt particles, he observed amongst them some of the same figure with the crystals, viz. hexangular; and as the rock crystal was of an hexangular figure, terminating in points of the same shape; so likewise had these coagulated salt particles two hexangular points, as represented by Fig. 38. between L and M.

M. *Leeuwenhoeck* supposed, that in case the rock-crystal in its coagulation had lain in such a position, as not to be united at both extremities, but only in the middle, they would then have been composed of two hexangular points, as we see in salt-petre; which in coagulating in the water, and fastening one of its sides to any other substance, is not only hexangular, but its extremities which run into a point, are not always hexangular like crystals, but oftentimes of the form of a chissel.

Fig. 39. represents in N and O a little particle of crystal, which tho' very small, he could perceive to be of a triangular figure, two of its angles being larger than the third; he also observed, some salts resembling Fig. 34. between A and B, having a thickness which was visible to the naked eye; besides, a great many other irregular salt particles; which were very numerous in a small quantity of water; he caused the water, that almost always surrounds the salt particles, to exhale leisurely by the warmth of a candle; and then he could discover a great many small coagulated salts without any discernible figure.

An Account of Lake Vetter, in Sweedland; by Dr. Urban Hearn. Phil. Trans. N° 298. p. 1938. Translated from the Latin.

LAKE *Vetter* lying from north to south, is from *Asker-sund* of *Nericia* to *Jonekoping* of *Smoland*, 14 Swedish miles in length, (one of which makes five or 6 English miles, and 10 of them almost a degree) it is three miles in breadth, and in some places hardly two; it divides *Gothland* into two parts, the one situated to the east, is commonly called *Ostrogothland*, and the other to the west, *Westrogothland*; on the *Ostrogoth* side lies the famous mount *Abme* or *Ohme*, as also the city and castle of *Vadstein*; and on the *Westrogoth* side stands

stands the ancient town of *Hio*; the lake itself, by reason of the high ridges of mountains, that in several places stand close to its banks, and in other places at some distance therefrom, always appears depressed on the sides; it is of a considerable depth, yet so unequal, that in some places it cannot be sounded with 80 fathoms, and in several places on the *Ostrogoth* side, and in some few on the *Westrogoth* side, not with 300 fathoms: One *Benedict Amberni*, a citizen of *Vadstein*, founding the depth of lake *Vetter*, hard by *Groenenburg*, let go several fathoms of line, to which he had fastened an ax instead of a plummet, but he could find no bottom; there is such another abyss at the precipice of mount *Ohme*, called the *Western-wall*, so that there is no coming near it with safety for fear of the west wind, which suddenly rising, soon drives their boats, notwithstanding their throwing out anchors on all sides, against these declivities; in like manner Count *John Oxenstiern*, having attempted to try the depth at a certain place of *Westrogothland*, with 300 fathoms of line, could find no bottom; this lake is not only deep, but its waters are clear, so that at a considerable distance one may see a small piece of money at the bottom; a little below the surface, the water appears tinged as it were with green; and indeed it is surprising, that the filth conveyed into it from so many marshes, mountains and woods, should not in the least affect its clearness: Tho' lake *Vetter* exceeds several other lakes in largeness, yet for the most part it is free from rocks, and has but very few islands; the principal of which (where the counts of *Brake* formerly had their seat) called *Visingsoe*, lies in the middle of the lake, between *Groenenburg* of *Smoland* and *Westrogothland*, as the island *Rokne* does to the north, and directly opposite to the mineral springs of *Medevien*; there appear other islands close to the shore, but they are both very few in number and small; seeing then lake *Vetter* is thus exposed to the winds, and surrounded on all hands with high mountains, it is not surprising, that it should be seldom calm, and that being frequently agitated with storms, its high and confined waves should beat violently upon boats, and other vessels; and that oftentimes so suddenly, that the waters, which appear as smooth as a mirror, begins to be in commotion, before the least breath of wind is perceived; which seems to be owing to a tempest, arising somewhere from under the waters, and gradually protruding them; for it is no uncommon thing for boats to be tossed with a violent storm in one part of lake *Vetter*, whilst others not far off, are forced to

row by reason of the calm; and that such eruptions of waters are copiously promoted by subterraneous winds, seems to be confirmed by various phenomena; for immediately before a storm, and whilst the sky is still clear, there is perceived a hideous noise like thunder in the waters, which Dr. *Hearne* himself had often heard, whilst the air was very calm, and which was always followed by a great storm; this the inhabitants of *Visingfoe* perceive more sensibly than any others; for from that part of the island, whence the winds are to arise next day, their ears are stunned with a confused sort of noise, like that of the firing off cannon; and when these bellowings are heard in the east, commonly the east wind blows with hail and rain; it is worth while to consider those various sufflations, and sudden rising of vapours and exhalations, that some have observed on this lake; which is also confirmed by *Abraham Winandz*, who travelling that way, observ'd whilst the waters were very calm, a great number of little clouds, like so many darts, proceeding here and there from the bottom of the lake, and which uniting in the air, formed a misling rain; all which plainly shews, that this is very much owing to subterraneous winds; and the same subterraneous wind, undoubtedly, together with that from above, is the cause, why in spring, the ice which this moment is strong and thick enough to bear horses and sledges, is entirely melted the next; whereby, so sudden a thaw is occasioned over all the lake, that where you could a little before be carried with safety by horses, there now you might sail in a boat; these surprising bellowings of the waters, that precede this terrible eruption, warn travellers to make the best of their way; and such of them as are at some distance from land, are either directly drowned, or obliged to float for some time upon shoals of ice, in continual peril of their lives; sometimes, the ice with the least blast of wind sinks suddenly to the bottom: Whether metalline exhalations contribute to raise these subterraneous winds, the Dr. will not determine; but that there are such in this place is plain, from the various mountains situated to the northern parts of lake *Vetter*, *Nericia* and *Westrogobland*, which are replenished with veins of iron, and perhaps nobler metals, as also with several species of minerals; as antimony, magnesia, lime-stone, different lead ores, oker and pyrites, from which sulphur, vitriol, allum and other mineral juices, are usually extracted; and even in the very waters there is found a great deal of pyrites, and lumps of a certain kind of ferruginous oker, little pieces of which the Dr. himself had often

often gathered; to this is owing the *Ignes fatui*, which are not only frequently observed on shore, but are likewise in the night-time seen flying about the middle of the waters, and dazzling the fishermen; and this several take to be owing to metallic and sulphureous exhalations; and indeed, without mineral vapours, granats, porphyries, jaspers, crystals and other precious stones could not be generated in this lake; and these bear so good a polish as to be used for wedding ornaments, all which shew their metallic original.

Amongst the other properties of this lake, its surprising whirlpools and violent currents, under water are no less remarkable, and which directly opposing the winds and waves give a great deal of trouble to the fishermen; from hence it is supposed, and by reason of its unfathomable depth, secret streams and subterraneous winds, that there is a communication under-ground between this lake and lake *Venner*, which is distant 10 *Swedish* miles to the west; and this seems to be confirmed by the several whirlpools that lie between these lakes two of which (in the parish of *Fegte*) called the white and black whirlpools, *Haddorpius* a famous *Swedish* antiquary, sounded and found them vastly deep, and in them observed an intestine motion, and swelling as if they fermented; what further countenances this opinion is, that some years without any visible cause, the waters increase, and remarkably decrease again the following years: M. *Daniel Rydelius*, pastor of *Motala*, observed, that lake *Vetter* for these seven years past, had fallen in some places so sensibly, that he could walk dry for several fathoms, where formerly he was obliged to go in a boat, tho' there had been a great deal of rain; as in the years 1680, 1682, 1684 and 1685; but in the year 1686 towards autumn, the waters were observed to increase again gradually to the year 1688; whether lake *Vetter* swells at stated times, as those who sounded lake *Venner* contend, that it rises and falls every 7 years alternately, Dr. *Hearne* cannot determine; it is also remarkable, that the firing off cannon at *Stockholm*, and other places 30 miles distant, is in a clear day sensibly perceived here.

As to the accounts *Olaus Magnus*, *Messenius*, and other historians, give of *Gilbert's cave*, in the island *Vising soe*, the Dr. leaves their authors to answer for them; it is true, there is a cave, which yields a sulphureous and nauseous stench; owing as he supposes, to the cave being situated in a marsh near the water, and to the dirt collected by length of time therein,
from

from which are exhaled sulphureous and moist vapours; rather than to any of the causes commonly alledged for it.

The river *Morala* is the only mouth whereby lake *Vetter* discharges itself; at certain times, it loses as it were, its fluidity, and is so stopped up in its course, that a person may safely enter it, and sometimes easily catch the fish that are left in the channel, as happened about *Christmas*, 1682 and 1685; and according to the natives, this always portends famine, war, or some public calamity; tho' those who live hard by this river endeavour to account variously for this phenomenon; as by supposing that at that very instant the waters receding from their banks, sink to the bottom; yet the Dr. suspects, that the lower parts thereof are obstructed either with ice or snow, and that these are a kind of bulwark to the inferior waters, which in the mean time discharge themselves into the sea; and what made the Dr. think so, was, that this never happens in spring, summer or autumn, but always either at *Christmas*, or at the beginning of the new year; because, this always happens near a bridge, where the water not being above three ells deep, the bulwark and stones, that defend the bridge, stop the course of the river; this opinion is confirmed, from those isles and congealed snow that adhere to the longer weeds that grow at the bottom, which driven down by the current towards the foundation of the bridge, must in time be accumulated, and that to such a degree, as to stop the course of the river; and the millers thereabout affirm, that immediately before this obstruction of the stream, large lumps of snow are conveyed from the lake, which sticking like glue to whatever bodies they meet with, do gradually sink to the bottom; nor is it unusual for the waters to be one day quite calm all over the lake, and the next, by being put into a commotion, to be stopped at the bridge; whatever may be the cause thereof, it is still surprising, that this obstruction happens not in the severest cold weather, but in a milder season, and that generally about *Christmas*, and *New Year's-day*; perhaps, the rigour of the cold still remains under water, tho' it may be abated in the open air; or perhaps, the ice being but gently frozen, and detain'd by weeds and other things that come in its way, occasions these obstructions.

There is a certain fountain not far from lake *Vetter*, near the church of *Nye*, called the hungry or prophetic fountain, because it never has plenty of water, but when there is a

scarcity of corn and provisions the following year; it is encompassed with crumbling sandy hills, between which lies a low vale, without any marshes, from which this spring proceeds by secret passages; wherein this is remarkable, that in a rainy summer it is commonly dry, whereas in the driest summer, upon an approaching famine, or as some suppose, an impending war, it overflows the king's highway at *Motala* and *Vadstein*, as several living thereabouts can testify: In 1685, which was a very rainy year, this fountain was entirely dried up; in the summer of 1686 the water was observed to increase; and the very dry summer of this present year 1705, will not permit us to call in question the truth of this relation; for when all neighbouring fountains were quite dry, this had a very plentiful stream: What is principally worth observing is; 1. That of all the places that are near this fountain, a scarcity is threatned only to *Ostrogorbland*. 2. That in all this country, especially near the fountain, the soil is sandy, and in some places hard and clayey, to impregnate which, a sufficient quantity of moisture is always requisite. 3. That therefore corn is scarce in those parts, only in dry seasons; whilst it is otherwise in *Femtria* and some other northern provinces. 4. That meteors and storms sometimes follow the genius of the soil. 5. That the waters of this fountain, being as it were strained thro' the sand, are collected near these sandy hills. 6. That it is possible from physical causes these waters may increase or ascend in a dry, and decrease or sink again in a wet season.

Experiments on the Reflition of Bodies in common Air, in Vacuo, and in condensed Air, as also on the Descent of Malt Dust in Vacuo; by Mr. Francis Hauksbee. Phil. Transf. N^o 298. p. 1946.

MR. *Hauksbee* having provided a tall receiver, in the upper part of which he had a contrivance to lodge four marbles, and from thence he could at pleasure drop them successively upon a plane; the distance of the descent of each marble on the plane was about 13 inches and a half; the weight of two marbles was 59 grains, and that of the other two was 63 grains; the plane whereon they dropped was a round flat piece of solid glass, about an inch thick, and three inches and a half over, its upper surface was well ground and polished, it was fixed in a tin frame, contrived on purpose to keep its lower surface from being contiguous to the plate or leather, on which the recipient was placed; upon

upon dropping the marbles upon the said glass-plane, the resili-
tion was something more than that in common air; and those
dropped in common air, had likewise some small advantage in
their rebound, above those let fall in condensed air, the conden-
sation being but one atmosphere; for any more would endanger
the breaking of the receiver; the resili-
tion of the marbles from
the plane *in Vacuo*, was about 10 inches and $\frac{1}{4}$, which was some-
thing more than $\frac{1}{2}$ of their descent; in condensed air their re-
bound was about 10 inches; so that we must account their resili-
tion in common air, to be the medium of the other two; it being
difficult to judge to a nicety in so sudden a motion; but there
was a sensible difference between those dropped *in Vacuo*, and
those in condensed air: Mr. *Hauksbee* could not observe, that the
small difference in the weight of the marbles made any discernible
alteration in their resiliations.

Mr. *Hauksbee* took some malt-dust, and having dried it well,
he put a quantity thereof into a fine muslin bag, where being
loosely inclosed, it would, upon shaking, discover itself plenti-
fully in the open air, undulating and floating a considerable time,
before it would descend; but upon being included in a receiver,
from which the air was well exhausted, and then shaken, the
dust descended like a ponderous body, precipitating in streight
lines from the top to the bottom of a tall receiver.

*Ossifications or Petrifications in the Coats of Arteries, particu-
larly in the Valves of the great Artery; by Mr. Cowper.*
Phil. Trans. N° 299. p. 1970.

HOW far anatomical enquiries inform us as to the true seats
and causes of diseases, which have been ascribed to the
want of spirits in some, and of radical moisture in others, espe-
cially aged people, &c. may be seen in some measure by the two
observations, amongst others, in *Phil. Trans.* N° 280; since
which Mr. *Cowper* met with several like instances in aged people,
particularly in the leg of an old gentleman, whose toes and foot
were sphacelated; the dissection of morbid bodies, does likewise
very often informs us of the true use of the parts, as appears by
the following instances; the ossification or petrification in the
great artery, at its rise from the heart, has been observed so com-
monly, that some take it to be constant; how it may be in some
animals, Mr. *Cowper* cannot certainly say, but in human bodies
he is well assured, that whenever it happens, it is a disease, and
in some measure incommodes those parts in the proper execution
of their functions, as is evident from the following cases; a thin

man about 30, who languished with an ulcer in the thigh, attended with a *Caries*, or rottenness of that bone, at its articulation with the *Tibia* and *Patella* called the knee, where all these bones were affected, at length fell into a true *Phthisis*, and he coughed up a great quantity of *Pus*; some months before the patient's death, Mr. *Cowper* frequently saw him, when he would often offer him his wrist, to feel his unequal pulse; the artery there missing sometimes one, sometimes two strokes in six or seven; at first the patient told Mr. *Cowper*, that he observed it missed but one in ten; but at length these stops become more frequent, especially, on any agitation of the body or mind; tho' a *Polypus* in any of the large vessels about the heart may induce that symptom, yet its continuance so long before death, shews it owing to some other cause, as appeared, on opening the heart and great artery of this person.

Plate XIII. Fig. 1. represents the trunk of the great artery opened and displayed; *aaa* the three semilunar valves of the *Aorta*, which hinder the blood from returning to the heart, after it is expelled thence by its *Systole* or contraction; these valves were in this case somewhat thicker, and not so pliable as they naturally are, and they did not so adequately apply to each other, as is expressed by *aaa* Fig. 4; whence it happened sometimes, that the blood in the great artery *AAA* Fig. 1. would recoil and interrupt the heart in its *Systole*; but this stubbornness of these valves was owing to a bony or stony substance represented by *b* in the said Fig. which appeared much plainer, when the valves were dry, as represented in Fig. *; *aa* the two valves stretched out and dried; *b* the petrification or stony substance at their conjunction; in this instance, Mr. *Cowper* observed the left ventricle of the heart, expressed at *GG*, *DD*, *ee*, *ff* Fig. 1, to be a little dilated from its natural size, but was not by two parts in three so big as the left ventricle of the heart of another subject he had dissected; the symptoms for some years before the death of this person, who was about 30 years of age, were an extraordinary shortness of breath, especially on any fatigue, with an intermission of one pulsation in three; the posture of sitting up was more eligible than any other; he complained of great faintness, and now and then of a pain about his heart; the extreme parts were often cold, which towards his death increased more and more upon him, his legs and arms being mortified some hours before: Upon opening the chest, the heart, particularly, its left ventricle, was found larger than that of an ordinary ox, and filled with coagulated blood; the valves of the great artery

A A Fig. 1. were petrified, inſomuch, that they could not approach each other, as represented by Fig. 2 and 4. but an oriſice ſhewn at Fig. 3. remained always open by the petrifications *bb* Fig. 3. and *aa* Fig. 5, which had clogged theſe valves, and hindered their application to each other, as in a natural ſtate is represented by *aaa* Fig. 2 and 4.

The explication of the ſymptoms in both theſe caſes is obvious enough, for tho' the perſon, in the firſt inſtance did not die of the ſame diſeaſe with that in the other, yet the ſymptoms in his illneſs plainly ſhewed what muſt follow, from the diſorder of theſe valves, as they are rendered more or leſs uſeleſs; for as their office is to prevent the return of the blood into the heart, in its *Diſtole*, by exactly ſhutting up the paſſage of the *Aorta* (like the valves in water-engines) ſo, if by any accident they are hindered from performing their functions, as they were by the petrifications mentioned; the conſequences muſt be, not only a re-gurgitation of blood into the heart, but they baulk its impulſive force, when the muſcular fibres in theſe valves, cannot contract to prepare the paſſage for the blood of the left ventricle, when it is to be expelled into the *Aorta*; hence, the intermiſſions of the pulſe in the firſt inſtance may be accounted for; in the latter inſtance, theſe valves were wholly uſeleſs, and the circulation became more difficult, as appeared by the refrigeration of the extreme parts, mortifications, &c. In both theſe caſes the left ventricle of the heart was dilated proportionably to the bad conſtitution of theſe valves, which plainly ſhews that theſe valves give ſuch aſſiſtance to the heart, as it cannot be without, and that it gradually ſuffers according to their indiſpoſition: Mr. Cowper had an opportunity of obſerving a like inſtance, in an elderly gentleman about 72, who ſometimes had intermiſſions in his pulſe ſeveral years before his death, in whom Mr. Cowper found divers petrifications in the mitral and ſemilunar valves of the left ventricle of the heart.

Fig. 1. represents the left ventricle of the heart opened, &c. A A A the inſide of the *Aorta* ſlit open to the left ventricle; B B the bulbous trunk of the *Vena pulmonalis* divided and pinned aſunder; *aaa* the three ſemilunar valves of the *Aorta*, which hinder the blood from returning to the heart; *b* a ſmall ſtony ſubſtance at the conjunction of two of the ſemilunar valves, expreſſed at Fig. *; *aa* parts of the two valves dried; *b* the petrification, as it appears in the dried valves; C part of the lower trunk of the *Vena Cava*, cut off immediately above the liver; *cc* the left auricle opened and ſtretched out; D D the ſides of the left

left ventricle divided and drawn aside, to shew its inside *dd* *eeff* *GG*; *dd* the mitral valves of the left ventricle of the heart, or *Arteria pulmonalis* divided and turned aside; *ee* the *carnea Columnæ*, from which arise the tendons fastened to the valves *dd*, represented in Fig. 3. by *df*; *ff* a transverse tendon, whereby the *Columnæ carneæ* are drawn nearer each other in the *Systole* or contraction of the heart, when the blood is expelled into the *Aorta*; whereby, the tendons represented by *ff* Fig. 3 and 5. draw the mitral valve naturally; by which means, its orifice *gc* in the said Fig. is not only closed to prevent the return of the blood by the *Vena pulmonalis*, but at the same time opens a passage for the blood of the *Arteria magna*, by withdrawing the mitral valve *d* Fig. 2. from the orifice of the *Aorta* *aaa* *g*; *GG* the internal surface of the left ventricle, where it is somewhat smoother as it leads to the *Aorta*; *gg* the trunk of the coronary vein divided, when injected with wax; *hh* the coronary artery in like manner divided; *i* one of the trunks of the *Vena pulmonalis*; *kkk* the three orifices of the trunks of the *Vena pulmonalis*, as they open into the bulbous trunk, expressed at *BB*; *H* the cone of the heart.

Fig. 2 *A* represents part of the *Aorta* next the heart; *aaa* the three semilunar valves, as they appear next the heart in a natural state, whence the heart is in *Diastole*; and the blood hindered by these valves from returning to its left ventricle; *bb* part of the basis of the heart cut off; *ee* the two *Columnæ carneæ* of the left ventricle; *d* the mitral valve; *ff* the tendons arising from the *Columnæ carneæ*, and inserted into the upper and middle parts of the valve, as well as into its lower margin, which is better represented in the following Fig. *g* the orifice of the *Aorta* completely shut by the application of these three valves to each other.

Fig. 3. shews the same parts as in the preceeding figure, as they appeared, when the valves of the *Aorta* were petrified, excepting *a*, which represents a part of one of the valves that was not covered with the petrification; *bbb* the petrifications on the rest of the valves; *†* a small petrification on the mitral valve; *bbb* some of the transverse tendons, which draw the *Columnæ carneæ* to each other, when the heart is in *Systole*, for the more effectual closing the orifice of the mitral valve, represented here at *g*.

Fig. 4. and 5 shew the same parts represented in the two preceeding figures as they appear when viewed towards the heart, dried and displayed; *AA* the trunk of the *Aorta*; *aaa* Fig. 4. the

the femilunar valves in a natural state, when the blood in the arteries presses them close to each other; *bbbb* the trunks of the two coronary arteries cut off; *aa* Fig. 5. the femilunar valves petrified; *c* the orifice of the mitral valve next the *Vena pulmonalis*; *ddd* the internal surface of the mitral valve leading to the left ventricle; *eee* the *Columnæ carneæ*; *ff* their tendons; *gg* the transverse tendons, which draw the fleshy columns to each other when the heart is in *Systole*.

A dropsical Body dissected by Mr. John Lafage. Phil. Trans. N° 299. p. 1977.

MR. *Lafage* was called to open a maiden Lady 52 years of age, who complained about six weeks before, of a hard swelling in the hypogastric region on the right side; from which time her belly grew by degrees to an exorbitant bigness, the great weight whereof was the most considerable symptom, and at last suffocated the patient; the body was very much emaciated, and her legs were swelled a few days before her death; Mr. *Lafage* expected water, but there was only a viscous darkish humour, to the quantity of 18 gallons; after the evacuation of that matter, he perceived a large heap of vesicles arising from a thick membrane that covered the guts, it being the *Peritoneum* separated from the muscles; he took it out, in order the better to examine those vesicular bodies disposed on the outer surface of that membrane, as also those that were on its inside, towards the guts; the vesicles were of different sizes; some of the largest had been broken and sunk, others were broken and almost empty, and some were very much distended and full; the matter in all of them was of the same nature with the extravasated humours; what was contained in the smaller ones proved to be of a different colour and consistence, not unlike jelly, whites of eggs, gall and honey; in some it was much like the humour of a true *Meliceris*: There was but little matter extravasated in the cavity of the *Abdomen*; the greatest part was contained betwixt the *Peritoneum* and the muscles; the right kidney was affected with a particular dropfy; all the *Viscera* besides were in a natural state; two *Polypus*'s were found in the heart, and two pretty large stones in the gall-bladder.

An Improvement of the Hessian Bellows, &c. by Mr. Papin.
Phil. Transl. N^o 390. p. 1990.

THERE was an account of a new contrivance printed at *Leipsick in Actis Eruditorum Anno 1699*, with this title, *Rotatis Suctor & Pressor Hessianus*, which may be applied for wind, as well as for water; the shape of the *Tympanum* was cylindric, as represented by Pl. XIII. Fig. 6. where D A F C is the circumference; C P, D P, A P are the *Radii*; which bear the wings C m, D n, A o; C e is the aperture, thro' which the wind must be driven in the direction of the tangent C B; and it may be observed, that when the engine is working, every wing from the extremity of the aperture e, till it comes to the beginning of the same aperture C, always drives the same air, with the same swiftness, and at the same distance from the center; so that in going over all that circumference, the air finds resistance by friction, and acquires nothing at all; Mr. *Papin* therefore made the circumference in a spiral shape, as A F G B in Fig. 7. the *Radii* are A P, C P, D P, &c. the wings are A M, C N, D O, &c. the aperture is A B; and it is to be observed, that every wing in going round drives fresh air, because the air which is first in motion finds place to recede from the center towards the spiral circumference; and so it gives room to fresh air to come to the wing; and when the wings come near the aperture, they drive their fresh air into it without any friction; and the air which has been first driven and removed from the wing, cannot lose its velocity; because the wings which continually follow, do continually drive fresh air; this new shape of the *Hessian* bellows also affords another advantage; because, the air in going round, follows the spiral line, which is nearer to a straight line, than a circular rotation; and when the air comes to the aperture, it enters it without any loss of its substance; but in the cylindrical machine Fig. 6. the air always goes round in a circular manner, and when it comes to the aperture, the wind is driven straight on in the direction of the tangent, but just in the beginning at C; and afterwards the impulse is oblique, which obliquity is always increasing till the wing comes to the point A, and must occasion a great diminution of its strength: Mr. *Papin* made bellows of a spiral figure, where the radius A P was but 10 inches and $\frac{1}{2}$, the wing A m two inches broad, and nine inches high; because the *Tympanum* was likewise thus high, or a little more; the aperture A B was nine inches, or a little more,

so as to make a square hole; when Mr. Papin worked this engine with his foot, it made such a wind as could raise up two pounds weight; and without doubt a stronger man could do much more; but this is more than sufficient for the purpose, since there no more air need be driven than is enough for the respiration of such as can work in the mine; and wooden pipes may easily be made of boards, to convey the wind to the very bottom; so that the air will be continually renewed within, as well as without.

Mr. Papin made some trial of the *Hessian* bellows in a very strong fire in a furnace, to melt glass, iron, or any other hard metal; and tho' he could open the furnace above the matter to be wrought upon, yet no flame would get out thro' the aperture, nor could the cold air from without get into the furnace; so that it is very likely, this will be a great conveniency for several sorts of work, since men may work their materials when they are most softened in the fire; and they may be drawn up perpendicularly, so as not to be bent, as they are when drawn horizontally; Mr. Papin believes this would be a good way, especially for making with ease glass-pipes and looking-glasses of an extraordinary bigness; and he thinks that the *Hessian* bellows may be applied to several good uses, and so deserve very much to be improved.

An Account of the Age of Manuscripts, the Style of Learned Authors, Painters, Musicians, &c. by Mr. Humphrey Wanley.
Phil. Transl. N° 300. p. 1993.

THE substance of what a most reverend prelate writ to Mr. Wanley about manuscripts and copied writings was to the following purpose; viz. that it is not only possible, but very easy, upon the perusal of a written book, to pronounce in what age or century it was writ, supposing a man to be tolerably well versed in books of that language or country; and that this judgment may be made, only by observing the shape and figure of the letters of the book, which (like all other things) have their fixed periods of duration; as being formed one way in such a century, and another way in the next; time only (which alters the outward state of other things) working this change also in letters, of what age, language, or country soever they be: And then as to the original compositions; that the style or diction of any noted author being well observed, it is very easy to discover such others of his works, as have gone abroad, without his name; and also the very time when the author lived. Mr. Wanley acknowledges that it is evident, a person may judge of some

MSS. by the hand; and of the genuine and spurious works of some authors; and likewise, of the time wherein they lived, by their style; but whether this be so easy a work, and that the rules men generally go by in these cases, are always infallible guides, is what Mr. *Wanley* very much doubts of; supposing for instance, a man should bring to any antiquary a good M S. copy of the *Hebrew* bible, pentateuch or psalter, written in a small common letter, without points, fine knots, flourishes, pictures, or large letters, or any thing that would look pompous; and supposing that the ink, parchment, &c. should carry a seeming face of antiquity with them, and that a man should say his M S. was 1000, 1200, or 1300 years old, when really it was written within a very few years; could the antiquary from the hand alone soon find out the cheat? All the *Hebrew* MSS. Mr. *Wanley* had seen, were writ either in *Samaritan* or *Chaldee* letters; as to the *Samaritan*, he owns, they bear a good resemblance to each other; and that they differ very much from those *Samaritan* characters, which we find stamped upon divers truly ancient and genuine coins; but then there seems to be such a resemblance, as to the character, between those coins struck in ages far distant from each other, that it is hard (from the consideration of the metal, its fabric, weight, or from the shape of the letters in the inscription, &c.) to say, which coin was made in the time of *David*, or *Solomon*, and which no older than the time of the *Maccabees*; this being rather to be gathered from the words, and meaning of the inscriptions, than from the figure of the characters which compose them; the same may be said in a great measure, of the old *Greek*, *Punic*, *Roman*, *British* and other coins: The *Chaldee* character has indeed, varied in tract of time, according to the different fancies and humours of men; the even plain letter, he thinks, is the most ancient; this they altered into a more neat way of making it, as in *R. Stephens* *Hebrew* bibles; there is a third fashion, of waving the perpendicular strokes like rays, as in some of the *Hebrew* coins exhibited in the *Prolegomena* to the *Polyglot* bibles; then fourthly, there is a large fat letter in the M S. rituals and liturgies, besides the *Rabbinical* letters of *Italy* and *Germany*, with their offspring, the *Literæ coronatæ*, and perhaps others he never saw; not to mention here the *Jewish* custom of writing the vulgar languages of the country, wherein they live, in *Hebrew* letters: It seems a hard matter, to trace the original and progress of all these ways of writing, so as upon the bare sight of a M S. written in the *Hebrew* language or character, to say, by the shape of

the letters of this book it appears to be so old; and it seems much more difficult to assign the particular province or country, wherein each *Hebrew* book was written; as for instance, in *Italy*, *France*, *Spain*, *Portugal*, *England*, *Holland*, *Germany*, *Poland*, *Barbary*, *Persia*, *India*, in the several provinces of *Turkey*, &c. The same almost may be said of the *Greek* manuscripts, in which language there has been a great diversity of writing, according to the different humours of the scribes, the fashion then in use, or the manner of that particular province, in which such a book was written; nor is it easy (tho' a person would be apt to take such differences for so many land-marks) to tell the age of a *Greek* M S. without the date; and Mr. *Wanley* never saw such a date so high as the year 6400, according to the *Greek* computation; and it is still much harder, from any remarks about the character, illumination, ink, parchinent, paper, binding, &c. to find out what country, province, or island; such a *Greek* book should be written in, or what countryman the scribe should be; for if a man is born in one country, and writes a book in another, still retaining the character and manner of writing used in his own country, Mr. *Wanley* looks upon it to be the same thing, as if he wrote it at home; and therefore, he looks upon the *Greek* M S S. which *Angelus Borgecius* wrote at *Paris*, as if they were written in *Candy*, where he was born; and so amongst several others, to instance in a *Latin* M S. he looks upon a copy of pope *Gregory's* pastoral care (now in the *Bodleian* library) as a noble monument of our *Saxon* ancestors; tho' *St. Willibald* wrote it, perhaps at mount *Cassinum* in *Italy*; and afterwards, as it is probable, carried it with him into *Germany*, where it remained at *Wurtzburg*, till that city was plundered by the *Swedes* about 70 years ago: Mr. *Wanley* by exactly observing the nature of the characters, &c. of those *Latin* M S S. (whereof there is a greater plenty than of any others, and consequently may in some measure remove this difficulty) whose country he was sure of, has afterwards been enabled to say, that this book looks, as if it had been written in *France*, *Italy*, *Spain*, *Germany*, the *Netherlands*, *England*, *Ireland*, &c. and, it may be, about such a time: What further adds to the difficulty is, that it is known, that the shape of the majuscule letters found in *Greek* M S S. has been retained, for above 400 years together, with little variation; and also that some M S S. written in minuscles, and with accents, are older than some others which are without them; and likewise that the present *Greek* copists or *Librarii* have three or four different hands,

symonically used by them, one being their common hand, the others an imitation of old MSS. which are more beautiful (but troublesome and costly in writing) than their ordinary running hands; and thus Mr. *Wanley* has seen some very new things written in the same hand with books, which were certainly 400 years old.

What methods learned men have taken in order to inform themselves of the different ages of MSS. Mr. *Wanley* does not know, but his manner has been this; viz. he has been careful to get all the dates he could, wherein it was said, that such an individual MS. was written, at *such a time*, or by *such a particular person*; every book with a date, being as a standard, whereby to know the age of those books of the same or a like hand, and of those that are not very much older or newer; where dates have been wanting in some books, perhaps, they have had some succession of emperors, kings, popes, bishops, or other officers; and setting down the continuance of their predecessors for so many years, months and days, if there be only the bare name of him, who was the last in order (all other circumstances concurring) he then judges the book to have been written during the life or reign of such a person; especially, if that succession be afterwards continued by a more recent hand, or that there be two such successions, as of kings and bishops, and the last of each happen to be contemporaries; Mr. *Wanley* has made other observations from historical notes and ecclesiastical tables in some books; at other times one may light upon some authentic charter or original writing, in the same hand with such a book, as he has remembered to have formerly seen, but without any guess at the age of it, the age of the charter being known, that of the book is then also known; so that Mr. *Wanley* never entertains any notion or relies upon any observation, but as he finds it confirmed by the suffrage of concurring circumstances and sufficient authority; but even in some dates, he has found that they have been altered by later hands, for corrupt and base ends; some are so worded, that when a person takes the time they mention, to be the time when the MS. was finished by the copist, or book-writer, it is meant only of the time, when the author finished his composition; other books are post-dated, that they might be accounted new; of this last kind, is a *Greek MS.* Mr. *Wanley* saw in the university-library at *Cambridge*, which as appears by a written annotation therein, was bought such a year at *Rome*, for so much; and yet the date pretends, that the book was written at *Rome* in such a year, which happens to be two years after it was bought

bought and paid for; the reason of these post-dates was, because, before printing was invented, a book by how much the newer, was by so much the more valuable; and therefore, Mr. *Wanley* has found, in some catalogues of the MSS. formerly extant in our abbey-libraries, that when they said such a book was *Liber vetus*, they would often add *et inutilis*; but *Liber novus* was *nitidus, eleganter scriptus, lectu facilis*, &c. which mean opinion of the ancient copies, by the bye, may have been the occasion of the loss of many a good author: The *Librarii* or book-writers, were from the time of the *Romans* a particular company of men, and their business was a trade; but tho' book-writing was their profession, yet they had afterwards but $\frac{1}{3}$ part of the business: Learning, after the erection of monasteries was chiefly in the hands of the clergy; and they were for the most part Regulars, and lived in monasteries; amongst these, there were always several industrious men, who continually wrote new copies of old books, either for their own use, for the monastery, or for both, which seems to have swallowed up above half the business; then, if an extraordinary book was to be written, for the standing, and more particular use of the church or monastery, the antiquary must be sent for, to write it in large characters, after the old manner, and such a copy they knew would last for several ages, without renovation; between these two sorts of people, the writing-monks and antiquaries, the poor *Librarii* or common writers who had families to maintain, could hardly earn their bread; this put them upon a quicker dispatch, that so they might under-sell each other; in order to which, they would employ several persons at one time, in writing the same book (each person, excepting him who wrote the first skin, beginning where his fellow was to leave off) or else, they would form the letters smaller and leaner, and make use of more ligatures and abbreviations than usually others did; and this is the only account, Mr. *Wanley* can give, for that variety of hands, which in former ages, being learned of or borrowed from the *Romans*, was commonly used, and in fashion at the same time, and in the same country, throughout these western parts of *Europe*; and for their becoming less and less for one age after another, an instance of this may be given from the hands in *England*, which about the year of Our Lord 730 were of three sorts. 1. The *Roman* capitals, still retained and kept up by the antiquaries, in some books and charters. 2. The more set *Saxon* letters (which have a near affinity with the more ancient *Irish* characters, as being with them derived from the *Roman*) which were used as the common hand of the age, by the

the monks in their books, and some charters of their dictating and writing. 3. The running *Saxon* letters, fuller of abbreviations, and somewhat a-kin to the *Longobardic* and *Franco-gallic* (both which, with this third sort, were also of *Roman* original) were used by these *Librarii* in their books and charters; as also by some authors, who wrote much, as *Bede*, &c. There was another sort of book-writers still in vogue; namely, the *Notarii*, whose business it was to take trials and pleadings in courts of judicature; to write as *Amanuenses* from the mouth of an author; and to take homilies and sermons at church, from the mouth of the preacher; these *Notarii* made use of *Notæ* or marks, instead of letters; but when in process of time, letters were usually written small and quick, and abbreviations became common, the *Notarii* were discarded unless they would write books in long-hand, as other *Librarii* did, and their *Notæ* grew out of use, and most of their performances in notes or marks have since been destroyed: Supposing then, that a man had one *Latin* book of each of the four sorts abovementioned laid before him, written all at a time, and without any date or note of the age; would not he be ready to say, that the three first were older than the other? As that the book in capitals, was older, than that in the middling hand; and this again older than that in the running and smaller hand? And that such a book written with the *Notæ*, being all full of marks was not *Latin*, but of some other unknown language? But to come down later; supposing, that a person should have some more recent books or charters laid before him, in the pipe, text, exchequer, chancery, court, and common hands, all written at the same time, would not he be apt to say, that one seemed to him to be older than the other, and that they were the hands of several nations? If it be difficult for an inquisitive person to be a perfect master in all the successions of hands, that have been used in his own country, so far as he may be guided by the monuments extant therein (and Mr. *Wanley* never heard of any man that was such a master) surely it must be more difficult to pronounce from the hand, the age of those books, which were written in other countries, in an unknown language; and what may make a man still more liable to mistakes (besides the want of dates in the most ancient *Greek*, *Latin* and other MSS.) is the practice of several writers, still to use the very same hand, when in years, which they learned when they were young; like several old persons, who still continue to write *Roman* and secretary hands, which were more fashionable 30 or 60 years ago, than now.

As

As to the great easiness of finding out an author, and the time he lived in, by his style and phrase; Mr. *Wanley* observes, that people have learned the knack of changing their style upon occasion, so artificially, as not to be discovered, but when they themselves have a mind to be known: Who would have thought that *Erasmus* wrote the *Epistolæ obscurorum Virorum*? Or, that some of the nicer, nay, the most eminent modern critics could have been imposed upon by their familiar and near acquaintance, who trumped upon them their own recent performances for invaluable fragments of the ancients, whose other works, these very criticks had lying before them? It has been a frequent practice in all ages for poor scribblers to father their wretched offspring upon illustrious persons; and the disparity between the genuine works of the one, and the spurious pieces of the other being evident enough, it has been easy to distinguish between the gold and the brass; but Mr. *Wanley* would ask the question, is all that is now ascribed by learned men to some ancient voluminous *Greek* and *Latin* authors, undoubtedly theirs? May there not still some supposititious pieces lurk amongst them, which may have had the luck to be received, only because they have been more ingeniously counterfeited? Nay, may not the same person in the course of his life, even alter and vary his style and phrase unwittingly, and without any design to do so? Mr. *Richardson* in his answer to *Amyntor*, upon occasion of the difference in point of style between the revelation of *St. John* and his other works, between the prophecy of *Jeremiah* and his *Lamentations*, tells us, from *Dr. Cave*, that the consideration of the times when a man writes, or of the persons to whom, or the subjects about which, or the temper of body, or the humour he is in when he writes, or the care and pains that he takes in writing, may occasion such alterations in his style, as that no certain rule can be inferred from thence; and if it was really possible to find out the time when an author lived, only by diligently reading his works, surely, Mr. *Wanley* thinks, the world would have been long since agreed, as to the time when *Homer* lived, tho' they could not tell where he was born; and he believes, that in the list of ecclesiastical Writers there are some, and those not of the least consideration, who (notwithstanding their works have been read over and over) are still reckoned to be of an uncertain age.

As for pictures Mr. *Wanley* owns, that the works of several masters may be known by the hands, tho' they may be almost as different as their several hand writings; but, that one painter cannot copy from another so exactly, as that in tract of time it shall

shall not be known which picture is the original, is what Mr. *Wanley* will not assert: It has been frequently practised by painters to borrow pictures of those who are lovers and judges of such things, to copy them, and to return their copies for the originals, without any discovery made by the owners; and he believes it possible, tho' exceeding difficult, for a great master to copy a picture in such a manner, that when they both stand together, a good judge shall not be able positively to say, which is the copy and which not; nor can he that drew the original say, that he could imitate his own handy-work better than a stranger has done; and yet one would not think it much more difficult, for a man to imitate a drawing or picture, than to counterfeit another man's hand-writing, which some people can do very exactly; and others can with pen and ink so nicely copy after any thing that is printed, that a person would affirm their writing so have been printed off at press: As to the notion of discerning the age, as well as the hand of the painter by his picture, Mr. *Wanley* does not doubt, but that there is a great deal in it; and why, might not this notion be advanced a little farther, and the painter's complexion be known by his pictures, as well as his age? As supposing, that the sanguine naturally run upon portraits, poetical histories, nudities, &c. the choleric upon battle-pieces, sea-fights, fire-pieces, by land or sea, tempests, &c. the phlegmatic upon the still-life, flower-pieces, birds, beasts, fishes, &c. and the melancholic upon landscapes, architecture, pieces of perspective, not but that the different genius of a country, or the desire of a good customer, may oblige a painter to work upon a subject, which he has no great fancy for: As to the difference in the works of painters, grown old, in respect of what they did when young, Mr. *Wanley* questions, whether any certain rules can be establish'd as to their performances in that kind; but, as painters are generally known to live faster than other men, which may at length occasion a failure in their sight and memory, a trepidation in their hands, &c. yet Mr. *Wanley* never heard, that *Michael Angelo*, *Albertus Durer*, *Titian* and others, painted worse at the latter end of their long lives, than they did before; nay *Signior Vario*, tho' grown old, paints far better than ever, and is almost ashamed of some of his own works, which he painted at *Windfor* castle, in the time of King *Charles II*; there may be this in it, that aged persons having attained, thro' long practice, to a greater experience, to a more solid and mature judgment, than they had when younger, are more cautious of what they let go out of their hands, and correct those flashy touches of their pencils,

cils, and other superfluous irregularities, which they and others were formerly very fond of; as for the flame and motion of the eyes in a picture, or the breath in its mouth, Mr. *Wanley* can say but little; as to the painters painting a living or moving thing, so that one shall almost discern the motion, and see the bird flying, the horse, or hound running, &c. that is more easy; especially, when assisted with the friendly and pregnant fancy of the pleased spectator: In still-life, indeed, the eye is quickly deceived, and tho' there are several masters living more excellent at it, than ever *Zeuxis* and *Pharrhapius* were; yet still with all their art, it is very difficult to impose upon a man, so as to make him believe, that it is not a picture, but the very life he sees before him.

Musicians seem to be under the same predicament with painters, since they are observed to live fast, as also the poets; it is by the practice of several years, that they attain to a just knowledge and mastery in their respective arts; and as their first compositions are little and light, suitable to the mercurial temper of heedless and inconstant youth; so in time this wears off, and as their experience and judgment increases, their compositions grow more solid and sound; a young man may make a better minuet or jig, but the elder a more sound service or anthem: If it should be said, that the very best painters, musicians, and poets, died young, or at least, before they attained to an advanced age, when they would have failed, or grown dull, as others did; Mr. *Wanley* begs leave to say, that old men are of two sorts, either those who are much affected with their age, and weakened, or those who are not; if a man is born of unsound parents, or has lived all along in an air disagreeable to his constitution, or is always unhealthy, or lived an intemperate or debauched life, or has been crushed by any heavy misfortunes, or always lived in poverty or discontent; it is no wonder, if, in spite of all this, he attains to old age; but then, he will probably lose the clearness of his head, the fix'd attention of his mind, the brightness of his parts, which he might formerly be noted for; if a man has never had any of those disadvantages to wrestle with, but has all along been blessed with the contrary, then he being bred up to a profession, and always following it, his judgment therein still increases, and his hand (a person would think) should be more nimble and ready, and the man a better painter, musician, or orator, than ever; and why not a better poet too? For if Mr. *Dryden* (tho' he was said to have been unhealthy at last) would have taken as much pains, or had been allowed time to revise his latter poems, as in some of his former, they might have been as well, if not better.

received; so that Mr. *Wanley* does not see, that it is old age that does a man this dis-kindness, but rather that it is the accidents that do too often attend it, which yet many are free from to the last: Supposing then, that *Raphael*, or *Vandyke*, or Mr. *Purcell*, or *Alessandro Stradella* should have continued their practice of painting and music, till they had grown old; from the accidents attending which, suppose them (as a great many other people to be very free, might we not then have justly expected from them; even greater wonders than they had ever before performed? Mr. *Wanley* will not say, that an old general is fitter to be trusted than a young one, or that mareschal *Schomberg* at his death, was a better soldier, notwithstanding his age, than the present kings of *Sweden* and *Poland*; but rather that the study of divinity, or of the laws, does seem as nice and copious, as that of painting and music; now, the old and sage men of these professions, are every where most regarded, they are found to have the ripest judgments, and they are deservedly employed in the most weighty affairs appertaining to their professions; it has also been seen (as was partly said before) that some painters and musicians have not at all failed as they grew old, but kept that great reputation to the last, which they had before acquired.

Upon the whole, it seems to Mr. *Wanley*, that there is a gradual and sensible alteration in the appearance of things, and especially in the *scripture*, or hand-writing of M S S. now these ought to be considered with respect to the particular places, wherein they were written; every country is supposed to have remaining therein the greatest variety, and most considerable monuments of its own characters; unless they are known to have been carried away to other places; and therefore, if any man is desirous of considering the letters of any language, that has been confined to any particular region or province, it is but going thither; and it is ten to one, but, if he is diligent, he may satisfy his curiosity very well; for instance, supposing a person should be willing to consider the nature of the *Irish* letters, their original, progress, and variations, with their relation to the *Roman*, *Franco*, and *Anglo-Saxon*; this might be done chiefly, by travelling to *Ireland*, by taking a trip into the highlands of *Scotland*, and perhaps into the *Ile of Man*, and by consulting some *English*, and other libraries, whither some *Irish* M S S. have been carried; and supposing a person should consider the *French*, *Italian*, *Spanish*, or *English* hands, each country affords sufficient helps; but if a man would consider the letters of a dead or living language, which spread far, and has been, or is still used

in several countries, he cannot be supposed a perfect master in all the ways of writing that language, till he has considered the whole stage and succession of its letters in each of those countries; amongst those languages, Mr. *Wanley* reckons the *Hebrew*, *Arabic*, *Turkish*, *Armenian*, *Persian*, *Greek*, *Latin*, *Teutonic*, *Slavonian*, &c. and tho' *Latin* is common amongst us, and every body is ready to pronounce the age of a *Latin* M S. yet Mr. *Wanley* thinks they would do well to enquire where, as well as when a book was written; and if they are certain, that such a *Latin* book was written in such a particular country or province; it is then more easy, by considering the succession of letters used in that province, or by comparing it with other books written therein, to say how old it is; for want of this consideration, several learned persons have been almost always out in their calculations, and have pronounced at random; if then this method appears rational, and even necessary, in order to attain to a sufficient measure of this sort of knowledge; it follows, that it is no easy matter to assign the age, even of a *Latin* M S. no not even in *England*, where yet he supposes, that there may be as great a variety of *Latin* hands, as in most other countries.

As for painting and music, Mr. *Wanley* knows very well, that each painter's hand, and each musician's manner differs from another; but whether there is a gradual and remarkable variation from themselves, in the course of their lives, is what he never heard asserted; this is certain, that they can change their way of painting and composing at pleasure; and therefore, Mr. *Purcell's Dulcibella* is said not to be like his other music; and Mr. *Fuller* the painter could put one of his pieces upon Sir *Peter Lilly*, for a most incomparable picture of *Michael Angelo*; but then, these changes and variations from their usual manner are very seldom made; and a man generally pursues and practises that which is most agreeable to his own genius; for this reason, when a painter's hand is fixed, his manner is then limited; and so when a curious person comes into a gallery, he knows that this picture was done by *Ryley*, *Kneller*, *Vandyke*, *Dobson*, *Tintorer*, &c. and that to be a copy after *Reubens*, *Georgeon*, *Sala Rosa*, *Han. Caraccio*, *Pietro di Cortona*, &c. and when he comes to an *Opera*, to a *Consort*, or to *Church*, not knowing before hand, what music is to be performed, yet he may soon discern, that it was composed by *Corelli*, *Bapst*, *Bassani*, *Charissimi*, *Blow*, *Purcell*, &c. and so upon reading an ancient author, a sagacious and learned person may find, that he writes, according to the manner of such an age, that the style imitates such another, or that

the book, tho' it bears such an author's name, yet might perhaps be more truly ascribed to another, with whose stile it more exactly agrees; as for instance, that piece of *St. Cyril's*, published from the *Escorial* M S. by *Barthasar Corderius*, is thought, by its son of the analogy in point of stile, to be *Origen's*; but then, whether all this can be always done, done easily, and without error, is the question; and it seems still a greater difficulty, certainly, to discover how old the painter, musician, poet, orator, or other author was, when he finished any one piece of his works, unless a man is plainly told so; this being a sort of knowledge, that those who have been otherwise sufficiently experienced in their several arts and professions, have not as yet pretended to.

A Person deceased of a Schirrous Tumour in his Breast, by Mr. Thomas Greenhill. Phil. Trans. N^o. 300. p. 2009.

MR. I. D. was supposed to have died of a consumption; forasmuch, as 14 months before, he had been violently seized with an inflammation of his lungs, accompanied with a sharp fever, difficulty of breathing, cough, acute stitches, and pleuretic pains, with a spitting of blood, &c. He was bled largely in the beginning, which was often repeated during his sickness; and he continually took such proper medicines as were prescribed him; but notwithstanding, about *Easter*, there appeared a tumour on the breast-bone, pap, and pectoral muscle of the left-side, with a fullness under the *Axilla*; from whence it was conjectured, a collection of purulent matter in the cavity of the *Thorax*, and that the *Sternum* was foul; the first, from the aforesaid tumours, and from his spitting a bloody and purulent matter; and the latter, from the rising and inequality of that part; but, upon Mr. *Greenhill's* opening him, he found his case very different, and surprising; for, as soon as he had divided and removed the common integuments of the *Thorax*, he found, instead of a rising of the bone with cariosity, only an oblong tumour, about four fingers in length, two in breadth, and of a proportionable thickness, weighing about three ounces; it extended itself perpendicularly on the superficies of that part of the *Sternum*, which joins with the *Cartilago ensiformis*; he separated it easily with a knife, from the breast-bone, and he found it to be of that sort of wens, or incysted tumours called *Atheroma*, containing a pappy substance, like sodden barley; next appeared a very large tumour on the left-side of the *Thorax*, covering the whole pap and pectoral muscles forwards, with a fullness under the *Axilla* of the same arm; then opening the *Thorax*, he found the

the same tumour, comprehending the intercostals, *Deltoides*, subclavian, and subscapular muscles, and the whole axillary and mamillary glands, which being obstructed, and its vessels replete with a creamy pappy matter, thicker and whiter than the former; there was produced such an induration of the aforesaid glands and muscles, which compose the upper part of the breast, that it may be more properly reckoned a schirrous tumour, which was on the outside of the breast, somewhat bigger than one's hand, extending itself from the clavicle to the lower part of the pap, and laterally from the basis of the muscle quite under the arm-pit; internally, it possessed a third part of the cavity of the breast, crowding the left lobe of the lungs to the right-side, and in its upper part firmly growing to it, which it likewise did every way to the intercostal muscles; it was about the bigness of a penny-loaf; and the whole tumour being considered together, it might reasonably be allowed to weigh between three and four pounds, which being cut in two, there ouzed out of it, as out of a squeezed sponge, a great quantity of thick, white, and pappy matter; and what is more particularly remarkable, there was formed a large sink or *Pelvis* in the middle of the axillary gland, which contained a thinner discoloured matter, and had a free communication to the vessels of the lungs, in the upper part of it, where it was united; and from hence it was, that the patient generally found ease, when he had somewhat emptied it by large expectorations, and that he could so exactly perceive when any thin rheum or matter flowed to the part; and it was here only that the lungs were black and replete with stagnated blood, and some globules of the aforesaid matter in its *Vesicula*; the rest of the lungs was pretty clear from any ulcers or matter, but they were of a sublivid colour, and strictly adhered on both sides to the *Pleura*, but particularly on the left-side, all about the schirrous tumour; the *Vesica Fellis*, or gall-bladder, was full of stones, of the bigness of a runcival pea, and consisted mostly of odd angles, and were formed of a thick viscous sediment of gall, (which was found therein) from an obstruction of its vessels, or jaundice, which the patient had had some years before; they were 22 in number, some triangular, others quadrangular, some quincuncial, &c. there was nothing else remarkable, besides a *Marasmus* of the external parts, the wasting of the caul, and an emptiness of all the *Viscera*, and blood-vessels in general.

A Pin found in the Gizzard of a Fowl; by Mr. Regnart. Phil. Transf. N^o 301. p. 2055.

MR Regnart, in cutting the stomach or gizzard of a fowl found something that resisted his knife, and upon examining it further, he discover'd it to be a pin, which the pullet had swallowed, and in all probability had lain there for some time; for it had pierced thro' the membrane on the inside, and made a passage into the thick part, where it had form'd itself a bed; it is observable, that the head of the pin had pass'd thro' the first shrivell'd membrane, but stopp'd at the second, which seem'd more thick and nervous; so that the head remain'd inclos'd between the two membranes, and the body had made its way into the fleshy muscular part; at the point there was form'd a *Callus*, of the bigness of a small pea, which seem'd to be a defence, that nature had form'd to oppose it, as it was working itself farther: It is not in the least surprizing, that a pin should lie in the fleshy parts, since we see, that a musket-ball will lie there a considerable time, without injuring the Part much; but, how it should pass thro' the membranes of the stomach, without obstructing its functions, and the pullet thrive well after it, Mr. Regnart leaves others to determine.

The Theory of Music reduc'd to Arithmetical and Geometrical Proportions, by Mr. Salmon. Phil. Transf. N^o 302, p. 2094.

MR Salmon, made a musical experiment, which was founded upon the following propositions; viz. That music consisted in proportions; and the more exact the proportions are, the better the music; that his proportions are the same that the ancient Greeks used; that the series of notes and half-notes is the same our modern music aims at, which Mr. Salmon in his experiment exhibited upon finger-boards, calculated in mathematical proportions; this was demonstrated upon a Viol, because, the strings were of the greatest length, and proportions more easily discern'd; but it may be accommodated to any instrument, by such mechanical contrivances, as shall render such sounds, as the music requires.

To prove the foregoing propositions; two viols were mathematically set out, with a particular fret, for each string, that each stop might be perfectly exact; upon these a *Sonata* was perform'd, by those two eminent violists, Mr. Frederick and Mr. Christian Stefkins; whereby it appear'd, that the theory was cer-

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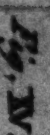
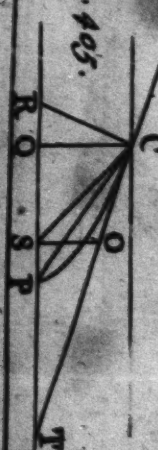
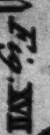
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tain, since all the stops were acknowledged by them, to be perfect; and that they might be prov'd agreeable to what the best ear and the best hand performs in modern practice, the famous *Italian Signior Gaspereni* play'd another *Sonata* upon the violin in concert with them, wherein the most compleat harmony was heard: The full knowledge and proof of this experiment may be found in Plate XIII. Fig. 8. 9. wherein music is set forth, first, arithmetically, and then geometrically; the mathematician may, by computing the proportions, be satisfied, that the five sorts of half notes here set down, exactly constitute all those intervals, of which our music consists; and afterwards, he may see them set forth upon a monochord, where the measure of all the notes and half-notes comes exactly to the middle of the string; the Learn'd will find, that these are the very proportions which the old *Greek* authors have left us in their writings, and the practical musician testify, that these are the best notes he ever heard.

Fig. 8. between the two lowest lines, you have the series of all the 12 half notes in an octave, from *A-re*, to *A-la-mi-re*, which added together make an octave or exact duple proportion; the several parts being also added together, make all those intervals, whereof it consists; as for example, the two half notes from A to A $\sharp$ $\frac{1}{2}$, and from A $\sharp$ to B $\frac{1}{2}$ make a major tone $\frac{2}{3}$, to which if an hemi-tone from B to C $\flat$ be added, you have a lesser third $\frac{4}{5}$: In like manner between the two next lines, you have the series of all the twelve notes, in an octave from C *fa-ut* to C *sol fa-ut*; the two first tones added together, make a greater third; and so you may add a tone or semi-tone, till you arrive at every interval in the octave, which is so call'd, because eight sounds are requir'd for expressing those seven gradual steps, whereby we commonly ascend to it; it may also be observ'd, that the proportions falling upon the same notes in two keys, one single board will be sufficient for both.

It is acknowledged by all that are acquainted either with speculative or practical musick, that each interval is divided into two parts, whereof one is greater than the other; an eighth $\frac{1}{8}$, into a fifth $\frac{3}{4}$, and a fourth $\frac{1}{4}$; again, a fifth $\frac{3}{4}$, into a greater third $\frac{2}{3}$, and a lesser third $\frac{1}{3}$; thus also a greater third $\frac{2}{3}$ must be divided into tone major $\frac{1}{2}$, and a tone minor $\frac{1}{6}$; the lesser third (to comply with the practice of musick) is rather compounded of than divided into a tone major $\frac{1}{2}$, and an hemi-tone, which is its complement, $\frac{1}{6}$; three tones major, two tones minor, and two of the aforesaid hemi-tones, placed in the order

order found in the figure, exactly constitute the practical octave; which is so called, because it consists of eight sounds, that contain the seven gradual intervals; but it is also necessary to set down the divisions of the whole tones, which are the true chronic half notes, because there is great use made [of them in practical musick: To make all our whole notes, and all our half notes of an equal size, by falsifying the proportions, and bearing with their imperfections, as is the common practice may be allowed by such ears as are vitiated by long custom; but it certainly deprives us of that satisfactory pleasure, which arises from the exactness of sonorous numbers, which we should enjoy, if all the notes were truly given according to the proportions here assign'd.

It is very easy to satisfy ourselves in the arithmetical scheme, by those operations, which *Gassendus* has set down in his *manu-duction to the theory of musick*, *Tom. 5. p. 635*; as for example, his rule for addition is, that two proportions being given, if the greater number of one be multiplied by the greater number of the other, and the lesser by the lesser, the two numbers produced exhibit the compounded proportions; thus, take a practical fifth $\frac{3}{2}$, and a practical fourth $\frac{4}{3}$ for the two proportions given, multiply 3 by 4, and you have 12, then multiply 2 by 3 and you have six, which compounded proportion of six to twelve makes the practical octave $\frac{2}{1}$; thus according to *Gassendus's* arithmetical operations of addition, subtraction, multiplication or continuation, and division, is Mr. *Salmon's* whole system prov'd, which for the more easy application to practical musick, is set forth geometrically upon the six strings of a viol.

These six lines represent in *Fig. 9* the six strings of the viol in the common tuning, the sounding part of each string from the nut to the bridge is suppos'd to be 30 inches long; the two middle strings C and E are drawn out to 15 inches, the half of the whole; it is easy to measure every interval with a pair of compasses; suppose you are to take the 20th part of the string G, it is an inch and a half, for the first half note; if you take the whole note from G to A, it is the tenth part and must be three inches; after these are taken away, your string will be but 27 inches long; so that if you advance one note, or a major tone further, you must take a ninth part of it, which will be three inches more whereby you arrive at a greater third, being the fifth part of the whole string; thus, the series of all the notes may be demonstrated; all the strings are unison at the stops, where the tuning requires; so that, tho the proportions be carried

carried on as far as the frets allow, yet the string is open, the same with the stop of that string to which it is tun'd; and accordingly, the series of the notes proceeds as if they were all upon a monochord.

This calculation serves but for two keys A and C, which are call'd natural; because, they have no essential flats or sharps; but because the composer begins upon any key, and the series of notes must take its *terminus a quo* from thence; the instrument-maker can provide such moveable finger-boards, as shall serve exactly for every key; they are taken out and put in upon the neck of the viol with as much ease as you pull out and thrust in the drawer of a table; three, or at most five of them will be sufficient to accommodate all the keys that are made use of.

This mathematical fixing of the frets enables every practitioner who stops close to them, to give the proportions of the notes in a greater exactness, than can be done upon the bass-violin, or violin itself; since they may be set forth more perfectly by a pair of compasses dividing a line, than the nicest ear can direct; tho' the frets for the several strings do not stand in a straight line, and the places are also shifted in different keys, yet the ear naturally directs the fingers to them; insomuch, that those who have all their life time been accusom'd to stop upon frets, that go quite cross the finger-boards of their instruments, do with very little practice fall right upon these; such is the power of a musical genius, as may be undeniably prov'd, by those that play upon a violin; who, when they change the key, fall upon the right stops, tho' they have no visible direction where to stop, nor time to alter by the ear, the note they first pitch'd upon.

By this standard of regular proportions, may the voice be form'd to sing the perfectest notes; they are all the same in vocal and instrumental musick; if then the instrument which governs the voice be perfect, the ear will of necessity bring it to perfection; it is a pity that a good natural voice should be taught to sing out of tune, as it must do if it be guided by an imperfect instrument; and this may be the reason, why so few attain to that melody, which is so much valued; but since we now know wherein perfection lies, a constant practice will bring us to the attainment of it: The dividing wholes into chromatic hemi-tones is very necessary, but very difficult for the voice to be broken to; if it learns from an instrument, whose whole notes and half notes are suppos'd to be equal, the sound must needs be very uncertain and very unharmonical; whereas, the proportions being truly fix'd,

would bring it to perfection in the nicest and most excellent part of musick.

The chromatic hemi-tones are the smallest intervals our modern musick aims at, tho' the ancients had their en-harmonic quarter notes, which they esteem'd their greatest excellency; these may also in time be recovered, since we know their proportions; for as the diatonic tone is divided into chromatic hemi-tones; so after the same manner, may the chromatic hemi-tones be divided into these least en-harmonic intervals, which were always made use of; but if we go no further, yet this experiment demonstrates the true theory of musick, and brings the practice of it to the greatest perfection.

The Bones of a Human Foetus voided thro' an Imposthume in the Groin; by Sir Philip Skippon. Phil. Trans. N° 302. p. 2099.

SIR Philip Skippon visited a woman in Drury-lane 66 years of age, who had a child consum'd in her Uterus for about 28 years; she bore two children after this, the one liv'd 11 years, and the other six, about eight years before Sir Philip saw her; an imposthume broke out in the right Inguen, and then several bones of a dead child were expelled, some of which he had by him; the patient had still a large swelling in that groin where she felt somewhat very hard, which she suspected to be bones.

An extraordinary Case of a Costive Person; by Mr. Sherman, with an Observation thereon; by Mr. Cowper. Phil. Trans. N° 302. p. 2116.

ONE Thomas Philips, of Eastborp, near Keldon in Essex, was well in every respect, till he was a year and quarter old; at which time a very strange and almost continual rumbling in his intestines seized him, the consequence whereof was a violent looseness, for which all the physicians near the place could find no remedy; but at length, when the child's life was despair'd of, the looseness terminated in such an obstruction, that he did not go to stool for a fortnight or three weeks together, and from three weeks it proceeded gradually to the intervals of 17 or 18 weeks; and continued so, till he came to be about the age of 15, when his body resumed its natural temper, which lasted four or five years; but then the obstruction returned, and it increased till he died; for it was customary with him in the latter years of his life

life not to evacuate any *Fæces*, under the interval of 19 or 20 weeks, and sometimes, (twice at least) he had no discharge for 21 or 22 weeks together; he lived to be near 23 years of age, and walked about almost to the hour of his death; for he was suddenly seized with very sick fits, but could not vomit, two or three of which fits carried him off in a few hours, and he died nine weeks after he had had any stool: The patient never vomited, nor had at any time any excrementitious taste in his mouth; neither did he sweat much, nor make more urine, than in proportion to his drinking: When the patient went to stool, he evacuated several times in a day, and that for several days together; 'till he had emptied himself; and throughout his whole life, he never discharged any other than very thin *Fæces*; before the time of evacuation came about, he was of an extraordinary bigness several weeks before his going to stool, unless he could break wind, which he often endeavoured to do, by laying his body on the edges of a table or stool, but often to no purpose; he declined the use of any medicines for several weeks before he died, contenting himself with going to stool once in three or four months, or in 19 or 20 weeks, as abovementioned; but what was surprising, was, that he generally had a pretty good appetite, and eat and drank as the rest of the family did; nay, till the time that his body came to be very full, he could work at the plough, or such like husbandry labour.

Mr. Cowper observes, that it is not improbable, that had this person's *Abdomen* been opened, some of its contents would have been found not unlike those mentioned in his explication of the 34th table of *Bidloo's* figures; where Mr. Cowper observed in a young gentlewoman he had dissected, the *Omentum* so much diminished, that at first it appeared doubtful, whether that part had ever existed in that subject; but, upon a strict examination, the small remains thereof resembled a *Congeries* of small glands, stuffed with a suet-like matter; the whole intestinal canal, even from the *Pylorus* to the *Anus*, was distended with *Fæces*, and the surfaces of all the small guts adhered so closely to each other, that they could not be separated, without tearing their external membrane, to which the *Omentum* contributed by its adhesion; the whole *Compages* of the intestines very much resembled that of the external surface of the brain, covered with the *Pia Mater*; so that the mesentery in that subject could not be seen, till this external inclosure was divided; it is certain, that, by this disorder, the peristaltic motion of the guts must needs have been

very much impaired, if not quite hindered; the *Peritonæum* was likewise in that case very much thickened, and had several preternatural white bodies set at various distances on its internal surface; the like appeared on the stomach, which very much resembled in figure the milliary glands on the back part of the *Aspera arteria*.

An Eruption of Blood from several Parts of the Body, and a Colic arising from the Coalescence of the Intestines, into a thick and cartilaginous Substance; by M. Antonius Melaportus; Phil. Trans. N° 303. p. 2144. Translated from the Latin.

A Certain young woman had enjoyed a perfect state of health, was naturally of a chearful disposition, till the 18th year of her age, when having undergone a variety of disorders, she was afflicted with a flux of blood from unusual parts of her body, and at length with a dismal sort of partial sweat; after a lasting pain in her stomach, she began to cough up blood, occasioned by a spurious pleurisy with which she was taken, accompanied with a pain in her side, and a difficulty of breathing; the disorder in her breast going off on the fourth day after, she was afflicted with a head-ach, under which she had formerly laboured, and was observed to have an effusion of blood at the nose, yet without any relief; wherefore, the surgeon bled her largely in the foot, as he had formerly twice drawn a fizy sort of blood from her arm; yet for all this, her disorder did not decrease; after this, the patient had a *Cardialgia*, or heart-burn, which made her at first vomit up a viscid green matter, and then blood, and that in a certain regular period for many days, yet without being relieved of her head-ach; this troublesome vicissitude of disorders still continued to rage, when about the beginning of *May* her *Menses* returned, and that in a sufficient quantity, as she was wont to have them; after the seventh day, the surgeon gave her a potion of *Manna*, with which tho' she was very much disordered and seemed to grow worse, yet a little after, her fever entirely left her, which before had been more or less a continued fever, with watchings; her disorder had scarce intermitted for a week, when her fever returned again, attended with a pain in her joints, and particularly in her belly, from which tho' she was soon relieved by taking *Oleum Amygd. dulcium rectif.* extracted without fire, yet her continual vomiting and loss of blood, afflicted her much: To remove this dangerous symptom, the physicians advised bleeding in
small

small quantities, and at proper intervals, in the *Salvatella*, and the application of anodynes, astringents, &c. which tho' accordingly done, yet the disorder taking an irregular course, after it had gone the round of all the common excretories, began to flow at unusual parts; about the beginning of *June* blood run at her ears, a little after, at the points of her fingers, and then of her toes; presently after at the *Umbilicus* and corner of the eye; several times by sweat, and at length it burst out from the middle of her breast, afterwards in the foot, where the *Saphena* is prickt in bleeding; then at both palms and back of her hands; two days after it flowed from her chin, and in the night-time from the tip of her tongue, and all this in a fortnight's time: M. *Mesapori*us, paying a visit to this patient, was surprised to find, that she had some tolerable degree of strength and a cheerfulness of countenance; a small print, like an unequal puncture, was still to be seen in the palm of her left hand, from whence the blood had flowed the day before, and as she said, with a sensible pain; as was always the case when it flowed from any particular place; but when from her breast, or other parts like sweat, there was no vestige of an orifice to be seen, only the blood on her linen; on the 14th of *June* her *Menses* returning in a greater quantity than ordinary; some supposed, because it had intermitted for 20 days, that the disorder was removed; but a second sweat coming on, and continuing for some time, she found her strength impaired, and the discoloured blood appear; change of air proved ineffectual towards a cure, it rather made the patient worse.

M. *Mesapori*us happened to be present, when she felt a twinging pain in the extremity of one of her fingers, whereby she was apprised that an eruption of blood would soon ensue; he observ'd it to drop from a deep puncture, and immediately from another not far off; three days after she had a very plentiful bloody sweat, and little or none ever after; it was observable, that, from a slight excoriation above the *Malleolus*, occasioned by spraining her foot, there flowed a plentiful quantity of *Serum*, which could hardly be stopped either by stiptics, or bandages.

To confirm this surprising *Phenomenon*, *Fabricius Ardisonus* relates, that he cured a woman of 30 years of age, who had a suppression of the *Menses*, and flux of blood at the corner of her eye by promoting their regular course; and there are other similar instances to be found in authors, as in *Beniwenius*, *Hollerius*, &c. tho' in all these, some obstruction might occasion an extravasation, yet in the present case, obstructions can have no place; as appears from the very subtle crisis of the blood; whence at first,

first it was florid, and presently after sufficiently diluted; and tho' at first it was observed to be fizy, that does not at all evince the grossness of its substance, but only a greater elixation of its parts, which are apt to coagulate, as is particularly evident, in letting blood in the height of a fever; and as M. *Mesaportus* observed, of a young lady in an acute disease, that instead of blood, there flowed a white thin *Serum* from her vein, which afterwards coagulated; yet he acknowledges, that this is no ways an adequate cause to satisfy philosophers, whom he leaves to determine the precise and insensible disposition of the blood.

A country-man being for some time, extenuated and afflicted with gripes, and hypocondriac spasms, could hardly discharge any thing by stool; at length, being quite spent, he languished and died: Upon opening his body, the thick guts, especially at their flexure near the *Duodenum*, were found to be firmly united to each other, and the adjacent guts, by intermediate callous protuberances, so that they could hardly be separated; and besides, their substance was grown hard, like a cartilage, and become so thick, that there was scarcely any cavity remaining.

The solution of a Problem concerning the determinate Doses of Purging and Emetic Medicines; by Dr. Cockburn. Phil. Trans. N^o 303. p. 2119. Translated from the Latin.

THE better to determine the different doses of emetic and purging medicines, according to the variety of constitutions and ages; 1. We must suppose that such medicines cannot operate, before they have got into the mass of blood, and are entirely mixed therewith; for it is evident, that unless they provoke a *Nausea*, no sensible effect is produced by them long after they are conveyed thither. 2. That their more general effect is an alteration of the temperament of the blood, and other humours of the body: From these two *Postulata* Dr. Cockburn concludes, that where the *Crafsis* of the blood is the same, there the doses of medicines, to produce a determinate effect, should be proportional to the quantity of blood; for if for instance, a determinate dose is required to alter in a determinate degree, the *Crafsis* of one pound of blood; double that dose given to alter in the same degree, the *Crafsis* of two pounds; and triple, to alter in the same degree that of three pounds of blood, &c. and universally, if the quantity of blood *b* require the dose *d*, the quantity of blood *m b* will require the dose *m d*, and $b : d :: m b : m d$.

Coroll.

Coroll. Seeing the quantity of blood, and other humours that circulate regularly in the body, may be estimated from the weight of the animal, for the parts we call solids are only canals that contain those liquors; from hence it follows, that the quantities of doses, *ceteris paribus*, are proportional to the weight of the body; and consequently, that the dose of medicines to be given a new-born infant, is to the dose of the same medicines to be administered to a man of riper years, as the weight of the infant is to that of the man; e. g. 30 grains of *Pilul. Rudii* are generally given in one dose to a man, and the weight of a man is commonly 160 *l.* and that of an infant 12 *l.* wherefore, as 160 the weight of a man is to 12 the weight of an infant, so are 30 grains the dose of a man, to $2\frac{1}{4}$ grains, the dose of an infant; and the doses of infants are always to be augmented in the ratio of their increase; ever after the doses to be given continue the same to the 30th year of a person's age; after which time, both the quantity of the blood and strength are daily diminished, and in that ratio the doses of medicines should also be diminished: By this way of reasoning, which is the more simple case, Dr. Cockburn supposes, that all men enjoy the same temperament of body; as also, that the increase and order of the secretions are, to a number of years equal; but, seeing that the temperaments or constitutions of men are very different, according to the different *Crisis* of the blood, and other humours in the body, the quantities of doses are not always proportional to the weight of the body; that the different temperament of the blood consists in a certain disposition or cohesion in its particles, whereby the blood becomes more or less fluid; whence it happens, that the operations of medicines upon the blood are different, according to the different degrees of cohesion; for let us suppose, two men having an equal quantity of blood, but of different degrees of cohesion; it is plain, that those medicines shall more easily mix with the blood of a laxer, than with that of a closer contexture; and the propensity wherewith the particles of medicines mix with those of the blood, is always directly as the fluidity, or reciprocally, as the tenacity of the blood; and the force of the medicine upon the blood will in like manner be in the same ratio; and therefore, that a medicine may operate equally upon men of different constitutions, the doses to be administered should be proportional to the tenacity of the blood; supposing, the velocity of the circulation in both to be equal; but if the velocity of the blood be different, the operations of the medicines, that is, the quantity of secretions produced by them, will be as the velocity of the blood

blood; for the secretions in any gland, in a given time, are always as the quantity of blood, which is conveyed at the same time into that gland; that is, at its velocity; the velocity also of the blood, *ceteris paribus*, is always as its fluidity, or reciprocally as its degree of cohesion; if therefore the velocity of the blood were only to be considered, in that case the quantity of the doses to produce the same effect will be directly as the degrees of cohesion in the particles of blood.

Prop. I. *In two men having an equal quantity of blood, but of different degrees of cohesion, the doses of purging and emetic medicines, necessary to produce the same effect, are in a duplicate ratio of the degrees of cohesion in the blood.*

For, where the blood moves with the same velocity, the quantity of the dose must be as the degree of cohesion; and if the degrees of cohesion were the same, the quantity of the dose is reciprocally as the velocity; therefore, where neither the cohesion, nor velocity are the same, the quantity of the dose is in a ratio compounded of the direct ratio of the degrees of cohesion in the blood, and the reciprocal ratio of the velocity; but the reciprocal ratio of the velocity is equal to the direct ratio of the degrees of tenacity or cohesion; consequently, the quantity of the dose is in a compound ratio of that of the degrees of cohesion, and the degrees of cohesion, that is the doses to be taken are in a duplicate ratio of the same, Q. E. D.

Prop. II. *The quantity of doses to be given, men having different quantities of blood of different degrees of cohesion, is in a ratio compounded of the ratio of the weight of the men, and of the duplicate ratio of the degrees of cohesion.*

For, when the degrees of cohesion are the same, the quantity of the doses is as the weight of the men; and where the weight is the same, the quantity of doses is in a duplicate ratio of the degrees of cohesion; and therefore, when neither is the same, the quantity of the dose is in a ratio compounded of the ratio of the weight of the men, and the duplicate ratio of the degrees of cohesion, Q. E. D.

Coroll. Hence knowing the quantity and quality of blood in any man, it is not so difficult a matter to determine the doses necessary to purge and vomit him; this quality, or temperament of the blood, is easily discovered by a skillful physician from the pulse, urine, and other secretions; and therefore, a physician, observing the doses that purge men of a given constitution, may very readily determine the doses proper for any constitution or temperament.

Schol.

Schol. What has hitherto been demonstrated in general; which follow in like manner from the common hypothesis of physicians; about purging and vomiting; because the disposition, which the stomach and intestines have to be stimulated, is as the above-mentioned degrees of the quantity and cohesion of the blood; and thus the same truth would be very evident even from that hypothesis, tho' it has not that simplicity of a postulate, and for that reason is not made use of.

An Explanation of the Rule for finding Easter; by Mr. Jackman. Phil. Trans. N^o 303. p. 2123.

THE rule for finding *Easter* in the *Common Prayer Book*; is thus worded; *viz.* *Easter-day is always the first Sunday after the first full moon, which happens next after the one and twentieth day of March; and if the full moon happens upon a Sunday, Easter-day is the Sunday after; for the right understanding of which, it is sufficient to observe, 1. That the full moon meant is the 14th day of the moon, according to the kalender in the Common Prayer Book, (which may be called the Church Kalender) reckoning that day of the month for the first day of the moon, which has the golden number of the year collateral to it in the first column of the said kalender; and 2. That these words, next after March 21, are meant inclusively, as if it had been said, next after the commencement of March 21; so that if the full moon happen on March 21, the same must be the paschal full moon: Now, in order to prove that these observations are both right and sufficient for understanding the rule, Mr. Jackman only supposes, that if they are necessary and sufficient to reconcile the rule with the authentic table to find *Easter*; (from which practice never varies) then are they right and sufficient, which being premised, 1. he proves, that the just observation, is necessary to that end; because if the paschal full moon be any day before or after the 14th of the moon by the Church Kalender, then the rule and the table will clash; for 1. if it be any day before, then as often as the said 14th of the paschal moon is a Sunday, that very day, at latest, must be *Easter-day* by the rule; as being a Sunday after the full moon therein meant; whereas, by the table and practice, it is not till the Sunday following that; thus, Sunday, April the 1st, in 1705, was the 14th day of the moon by the Church Kalender; and therefore must have been *Easter-day*, or after by the rule, if the full moon therein meant had been any day before the said 14th of the moon; whereas *Easter-day* was April the 8th by the table, and accordingly observed;*

served; and this obliges us not to understand the true full moon, by the full moon in the rule; because that happens, about four days before the 14th of the moon by the Church Kalendar. 2. If the full moon meant in the rule be any day after the 14th of the paschal moon by the Church Kalendar, then, as often as the said 14th happens to be *Saturday*, and consequently the full moon meant in the rule to be the *Sunday* following at soonest (that being the very next day) that *Sunday* cannot be *Easter-day* by the rule; whereas by the table and practice it is: Thus *Saturday, April 4. 1702*, was the 14th day of the moon by the Church Kalendar; and therefore, if the full moon meant in the rule was any day after that, it must have been on *Sunday April the 5th* at soonest; consequently, *April the 12th* at soonest must have been *Easter-day*, by the rule; whereas, *April the 5th* was *Easter-day* by the table and practice; and this evinces the mistake of those, who make the 15th day of the moon to be the full, in the sense of the rule; as *Dr. Wallis, Phil. Trans. N° 240*; *Mr. Wright* in his postscript to his *Short View of Mr. Whiston's Chronology, &c.* as also the *Introductio ad Chronologiam* (reprinted at *Oxford, A.D. 1704*) p. 37. 2. *Mr. Jackman* proves the second observation necessary to the same end; because, a full moon in the sense of the rule, (*viz.* the 14th day of the moon by the Church Kalendar) often happens on *March 21*; and in that case the *Sunday* following is always *Easter-day* by the table, and practice; whereas, it must be a month after by the rule; unless we understand these words (*next after March 21st*) as *Mr. Jackman* explains them; and this will be the case the ensuing year, 1706; nor does the proof of this point need the supposition of the foregoing (tho' that may now be fairly supposed, as being already proved) for, compute the full moon how you will, *March the 22d* can never be *Easter-day* by the rule, unless *March 21* may be the paschal full moon by the same; and yet *March 22* is *Easter-day* by the table and practice, as often as the golden number is 16 and the dominical letter D.

Mr. Jackman was aware that the second observation might seem forced and unnatural; and that, perhaps, might induce some to reckon the 15th day of the moon for the full in the rule; and *Mr. Thornton, Phil. Trans. N° 297.* to substitute *March 20.* in leap-years, for *March 21*; neither of which hypotheses, however do any service, all things being considered; the former, indeed, would vacate *Mr. Jackman's* second observation (*March 21* never being the 15th day of the moon by the church kalendar) but then, it would make the rule notoriously irreconcilable with the

the table and practice, as has been already shewn; and as to Mr. *Thornton's* hypothesis; 1. The only colour for it (*viz.* that at the time of the council of *Nice*, the vernal equinox was *March 20*, in leap-years, and not *March 21*, as in common years) is, for any thing Mr. *Jackman* knows, more likely to be false than true, and does by no means follow from the intercalation. 2. If this pretence were true, it were too great a nicety, probably to have been regarded by the church. 3. This hypothesis puts more force upon the words of the rule, than Mr. *Jackman's* does; and lastly, if it were admitted, it would solve the difficulty only in leap-years; and Mr. *Jackman's* second observation would still remain necessary, because the case happens, as well in common as in leap years; whereof, we have an example in the year 1706; nor will Mr. *Jackman's* second observation be much questioned by such as know, and consider the inclusive way of reckoning used by the *Romans*, and from them derived to all the *Latin Churches*, and particularly that of *England*; for it is as proper to say, (*next after March 21.*) with the meaning Mr. *Jackman* contends for; as to say, *tertio ante calendas, nonas, vel idus*, in the sense of the *Roman* kalendar; or as to say (as our church does a little after this rule for *Easter*) that *Ascension-day* is 40 days after *Easter*, intending *Easter-day* itself to be one of those 40; and it is observable in this very rule, that after it had been said, *that Easter-day is always the first Sunday after the full moon*, &c. it is added, that, *if the full moon happens upon a Sunday, Easter-day is the Sunday after*; which had been a gross tautology, if by the first *Sunday* after the full moon might not be understood the day of the full moon itself, when happening to be *Sunday*; and if the *Sunday* of the full moon may be signified by the first *Sunday* after the full moon, then the full moon of *March 21*, may be signified by the full moon next after *March 21*. 3. He proves, that his two observations are sufficient to reconcile the rule and the table; because, Mr. *Jackman* himself had drawn up a table to find *Easter* for ever, by the rule understood according to those observations, and the plain and obvious sense in all other respects; and, upon comparing, he has found it agree in every particular with the table for the same purpose in the *Common Prayer Book*.

Some Norman Coins found at York; by Mr. Ralph Thoresby.
 Phil. Trans. N^o 303. p. 2127.

SOME workmen in digging below the foundations of a house that was burnt down in *High Ousegate*, discovered at a considerable depth, the foundations of an older fabric, very probably unknown to the builders of the latter house; these lower foundations were very well supported at several angles with good oak-piles, some of which were so firm and sound, that they were fit for that purpose again; besides these piles, there were several large timbers, that lay athwart, to make the foundation the stronger; betwixt the head of two piles the workmen found a little decay'd oak-box, wherein had been hoarded about 200 or 250 pieces of *Norman* coins; but time and the moisture of the place had defaced them in such a manner that not above 100 of them could be preserv'd; Mr. *Thoresby* having perus'd about half of them, found that they were of *William* the Conqueror's coins, and not above two or three in the whole of any other prince; those tho' later in time, are more valuable than several of the *Roman* and *Saxon* coins; and these lower foundations do likewise very well agree with the accounts we have of the timber buildings in those ages: The coins were very much alike; the king is represented full fac'd, with a crown and labels, but no sceptre, cross, or star, as Mr. *Thoresby* observ'd in other coins of his which he had; most of these coins were inscrib'd WILLEMV REX, which some have mistaken for *William* 2d; but by the declining of the strokes, it appears to be design'd for V, as Mr. *Thoresby* had one with the S after the V, and before REX; by this circumstance there appears a greater variety than was ever known before, of the Conqueror's money; Mr. *Thoresby* had such sorts as these, viz. WILLEMV REX. WILLEMVVS REX. WILLEMV REX. I. (which is not to be reckon'd a numeral letter, it being proper to pretend a distinction, when there was none of the name before; but for part of the letter A) WILEM. REX A are *Anglie*; and Mr. *Thoresby* had some coin'd on the reverse at LUNDRE i. e. *London*. Eofer wick (*York*) WINC. (*Winchester*) EXETE. (*Exeter*) LIN. (Mr. *Thoresby* supposes to be *Lincoln* *Lyn-Regis* not being old enough) LINCOL (*Lincoln*) DEOTFORND (*Therford*) and LOYNC (which Mr. *Thoresby* takes for *Loyn* or *Lancaster*:
 Mr.

Mr. Thoresby had one inscrib'd thus + WILLEMVREX
I, the reverle + DELL. IRDONLIN.

Several Experiments on the Mercurial Phosphorus by Mr. Hauksbee, Phil. Trans. N° 303. p. 2129.

EXperiment I. *Shewing that light may be produced from mercury, by passing common air thro' its body, after the receiver is well exhausted.*

Mr. Hauksbee took a glass recipient, open and ground at both extremities, whose contents were equal to about 30 ounces of water; the upper orifice was clos'd with a brass plate by means of a piece of wet leather laid on the edge of it; in the middle of this plate there was a stop-cock screw'd, from whose lower orifice was inserted by cement a small glass tube, reaching from thence to the bottom of a glass, included in the above-mentioned receiver; in which glass there was put as much mercury as would cover the bottom of the tube about $\frac{1}{2}$ of an inch; and being thus prepared and placed upon the pump, the stop-cock was turn'd to hinder the air passing that way, till the receiver was sufficiently exhausted; which being done, and the stop-cock returned, the air then rush'd strongly thro' the body of the mercury (by passing the tube above-mention'd) blowing it up with violence against the sides of the glass that contain'd it; and it appear'd all round like a body of fire, compos'd of a great many glowing globules; and it descended again into itself, the phenomenon continuing till the receiver was half full of air.

Exp. II. *Shewing that mercury will appear like a shower of fire whilst it descends in vacuo, from the top to the bottom of a tall receiver.*

Mr. Hauksbee having got ready a tall receiver about 21 inches high, to whose upper orifice there was screwed a glass (resembling those now commonly us'd for cupping) with an open passage thro' its neck, in which passage there was cemented a piece of a small tube, drawn taper at one extremity by the flame of a candle, which together with the cup made an entire funnel; its small aperture was stopped with a round piece of timber as a plug, to prevent the mercury entering the receiver before its time; within this tall receiver there was included a glass about 17 inches high, with a round crown like a shade; in this manner being placed on the pump, and about a pound and a half of mercury put into the funnel, the air began to be exhausted; and in two minutes time was sufficient to exhibit the *Phenomenon*; for then loosening the plug that stopped the funnel, the mercury, by the pressure of the air, was driven violently into the receiver, striking

striking strongly on the crown of the included glass, which broke the quicksilver into small particles, descending all round the exposed sides of both the glasses, and appearing like a shower of fire in a very surprising manner; the form of the receiver, as well as of the included glass, was very distinguishable by its light, and continued so, till all the mercury had entered thro' the funnel: What further occurred to Mr. *Hauksbee's* observation was, that the descending mercury did more resemble the falling of snow, by the slowness of its motion, than that of rain; and that none of it appeared luminous, but what descended contiguous to the sides of the glasses; and that some of the globules of mercury descended quicker than others, according to their different magnitudes; that the descending globules of light (as by a strict observation Mr. *Hauksbee* had afterwards made) did not slide down the sides of the glass, but were carried round by their own weight, as if they revolved on an axis; and what was remarkable, the descending globules had a double motion, the one perpendicular, the other like a rotation on an axis; and in that motion the adhering parts of the mercury were continually tearing from the sides of the glasses, producing an apt form, which in such a medium, from such a body exhibited light, that the smaller globules, whose weight was not sufficient to cause their descent, remained opaque, there being (in this, as well as all other mercurial experiments) no light to be obtained without motion; that the same motion given to the like globules of mercury in common air, does not produce the same effect, as Mr. *Hauksbee* tried, by forcing mercury thro' leather, which he did by condensing air strongly on its surface; from all which it seems to appear very plain, that there is requisite the concurrence of a proper figure, medium, and motion to produce the mercurial Phosphorus.

Experim. III. *Shewing, that it does not require so thin a medium, as is made by the weight of the mercury in the Torricellian experiment, to produce the mercurial Phosphorus.*

To try whether so thin a medium as a *Vacuum*, or the nearest approach to it, was absolutely necessary in the production of such a light, as is discoverable in the barometer, by putting the mercury in motion, Mr. *Hauksbee* made use of the gage belonging to his air-pump; upon the plate of the pump he placed a small receiver, from which the air being exhausted, the mercury in the gage was elevated to 29 inches and $\frac{1}{4}$; then permitting some air to re-enter the receiver by the cock, and the mercury in the gage descended, and made several vibrations before it became stagnant,

in

in all which it appeared luminous, only whilst descending, till the mercury was broke on purpose by a violent agitation thereof; then the separate parts appeared luminous on their lower surfaces, which became concave during their ascent, as the others were, when they exhibited their light in their descent, the convex surfaces being always opaque; these appearances continued upon every admission of air, till near the half was admitted; but after that, tho' the mercury had the same motion given it as before, yet no manner of light ensued; hence it readily appears, that tho' the mercurial *Phosphorus* in the *Torricellian* experiment, is not produceable in so dense a medium as common air; so on the other hand, it requires a medium not so thin by much, as the nearest approach to a *Vacuum* to effect it.

Experim. IV. *Shewing that a considerable light may be produced from Mercury in a glass, by putting it into motion, before the receiver is quite exhausted.*

Mr. *Hauksbee* having provided some mercury, which was very fine, and free from the least appearance of soil on its surface, the glass which held it being also very clean and dry; and both glass, and the contained mercury were included in a receiver on the plate of the pump, from which Mr. *Hauksbee* presently began to exhaust the air; but before it was quite exhausted (the mercury in the gage not exceeding 28 inches, the barometer at the same time standing at 29 inches and $\frac{1}{2}$) the pump was shaken, by which means the mercury in the included glass being put into motion, exhibited such a light, that not only the receiver and included glass were thereby distinguishable, but the hands and fingers on the outside were so too; it is to be observed, that tho' the mercury would exhibit a light upon a little motion, yet the light was increased upon increasing that motion; what further occurred was, that when a pretty brisk agitation was given the mercury, it would resemble waves of light breaking on the sides of the glass, scattering some species of the same appearance towards the upper part thereof; that upon the repetition of the experiment, three or four times the *Phosphorus* seemed to be more vivid every time; till at last, by often shaking the mercury, its surface became somewhat solid, which rendered the light less than it had been before; that in this, as well as in all other mercurial experiments, the light exhibited is of a very pale colour; that the first appearance of this light, is when about half the air contained in the recipient is exhausted, which still increases with the rarefaction; and with all the last confirms the necessity of a rarefied air to such a degree, to produce the mercurial
Phos-

Phosphorus, concurring with that made by the motion of the mercury in the weather-glass.

Experim. V. *Shewing very odd flashes of light (upon the repetition of the experiment) resembling a shower of fire.*

The appearance in this experiment was not only very surprising, but distinguishably the clearest and most vivid light in all the mercurial *Phosphori*, produced in rarified air: Upon the repetition of the second experiment, and with the same apparatus, the mercury did not only appear like a shower of fire, but from the crown of the included glass there were frequently darted flashes resembling lightning, of a very pale colour, and very distinguishable from the rest of the light produced; the flashes seemed then to be darted horizontally, tho' at other times Mr. *Hauksbee* had observed them to incline upwards, and sometimes downwards; and sometimes from divers parts, as well from the outer receiver as from the included glass; they generally fly to the side of the outer receiver (unless their origin begins there, as Mr. *Hauksbee* had sometimes observed) where the light breaks, and spreads in a very odd form; something farther observable was, that the crown of the included glass sensibly appeared more luminous than any other part thereof, which light was constant, without any alteration, during the descent of the mercury thro' the funnel, and that was at least two minutes of time; the quantity of mercury used for this experiment, was about three pounds.

Experim. VI. *Shewing that a great number of particles of light are discoverable, by shaking Mercury in a glass even in the open air.*

In some of the former experiments, where Mr. *Hauksbee* asserted that the mercurial *Phosphorus* is not produceable, but in such a medium, there he would have it understood, that he means a light of the same nature and quality with that discovered in the barometer, by putting the mercury into motion; which light is very different from what is made by shaking mercury in the open air, which was very sensible in the present experiment; for having put into a clean glass globe (whose content was equal to about 30 ounces of water) about $\frac{1}{4}$ a pound of pure mercury, then closing its mouth with a brass cap, in the middle of which was inserted a cock, by which means there was a free communication with the external air; the globe being shaken, the particles of light appeared plentifully, about the bigness of a small pin's head, very vivid, resembling bright twinkling stars, exhibiting some small faint light, like the whitish appearance of the

the *Via lactea*; their numbers increased according to the rapidity of the motion communicated to them; Mr. *Hauksbee* then took the same glass, with the same mercury, and applied it to the pump, by means of a hollow brass pipe, which screwed on, both to the cock and pump, and when the air was exhausted and the cock turned, to prevent the return of the air again, and when it was taken off, and moderately shaken, the mercury then appeared luminous all round, not as before, like little bright sparks, but like a continued circle of light, during that motion; but when that motion was checked with another of greater violence, it then appeared luminous almost all over the globe; upon suffering the air to return, that mode of light vanished; nor could any thing be recovered by shaking, but only the bright sparks, as at first.

Magnetical Experiments and Observations; by Mr. Derham.
Phil. Trans. N^o 303. p. 2136.

MR. *Derham*, having invented an azimuth compass, as he was preparing it for observing the magnetic variation, took occasion to try divers magnetic experiments, and by that means discovered this odd phenomenon; *viz.* having touched a piece of wire, so that it tended strongly N. and S. he had a mind to see whether it would have any inclination to either of the *Poles* of the world, when turned round like a ring, so as that the two extremities of the wire met; and having straitened it again, he was surprised to find it had quite lost its verticity; the cause of which, he presently concluded, to be the contact of the northern and southern extremities of the wire, which he thought might so influence each other, as to confound its poles; tho' he had never observed any such confusion to arise upon the bare contact of the northern and southern extremities of two other touch'd pieces of wire; hereupon, Mr. *Derham* touch'd the same and other pieces of iron wire strongly, and finding them all turn eagerly N. and S. he coiled them round in such a manner, that the extremities should not come near each other; and he again speedily opened them strait, and found as before, that every piece had utterly lost its verticity; nay, the magnetic virtue was so absolutely destroyed by bending the wire, that it had not only lost its inclination to either *Pole*, but the two extremities of each wire seemed indifferent to the poles of the loadstone; *viz.* whereas, before the bending, the contrary poles of the loadstone would repel, and the similar poles attract the adverse, or similar extremities of the wire; now the repulsive virtue

was quite extinguished, and either extremity would be indifferently attracted by either pole of the magnet, all one as if the wire had been heated red hot (which is well known to destroy the virtue) or never had been touched at all: This Mr. *Derham* had several times experimented upon wires of different lengths, with the same success; only this must be observed, if you only bend the wire round in such a manner, that it shall spring back into its place or recoil, so as to be nearly of the same straitness, that then no such, or but little of such effect will ensue; but to produce this effect, the wire must be sharply bent, so as that violence may be exerted thereon; if it is coiled two or three times about a small round stick, it will succeed best; and farther also it is necessary, that every part of the wire should be bent, to destroy the magnetic virtue; for if the extremities, or any other part happen not to suffer the violence of bending, that part shall retain its magnetism; as for instance, if the wire is all coiled, excepting half an inch, or indeed, half a tenth of an inch at each extremity, every part so coiled shall both lose its verticity, and shall incline indifferently to either pole of the magnet; but the two extremities (altho' not able to turn the whole wire N. and S.) shall fly from, or tend to the respective pole of the magnet; or if every part of the wire be coiled, excepting a small bit at each extremity only, all that coiled part when extended, shall be utterly deprived of its magnetism as before; and only that uncoiled bit retains its aversion, or inclination to the magnetic poles: From the consideration of all which particulars, it is very manifest, that the violence exerted upon the wire by bending, utterly extirpates the magnetic virtue, or at least makes such a confusion therein, that it is, as if it was entirely destroyed, which is a case very odd, and never taken notice of before.

Mr. *Derham*, consulting what others had writ of magnets, he finds in *Grimaldi de lumine & colore*, that both he and M. *de la Hire* in *Phil. Trans.* N^o 188. had hit upon the same discovery before him: Mr. *Derham* touched and coiled several iron-wires, but the effect that ensued was not such as he before related; the verticity was indeed much weakened, but not totally destroyed, and the extremities of the wire would be attracted or repelled by the poles of the magnet; whereas, he had said above, that they only were wont to be attracted; the next morning he tried again, and then the magnetism of the wires was entirely destroyed, as he related above; this experiment Mr. *Derham* repeated several times, and on several wires; and he commonly found, that all day, coiling will destroy the magnetism; but that

that it will not absolutely do so in the evening; but whether it will have the same effect in summer, or in all seasons, or whether it succeeds thus, only in different times of the day; Mr. *Derham* must leave to farther trials; he well knew that the orb of the activity of magnets is larger or less, at different times; that magnet in the Royal Society's repository found in *Devonshire* by Dr. *Cotton* is known in some weathers, or at some times to keep a key, or other piece of iron, suspended to another iron at 8, 9, or 10 foot distance; but at other times, the iron will drop down at the distance of three or four feet from the magnet; now, whether at all, or how far this may reach the above-mentioned case, Mr. *Derham* cannot say, not having made a sufficient trial of the matter: Mr. *Derham* tried the event of twisting iron-wire from one extremity to the other, after it had been well touch'd; the success of which was that the verticity was always weakened, and sometimes inverted; and when it was so, the loadstone commonly repelled or attracted, all one as if the twisting the wire had given a new touch the contrary way; but in some wires so twisted, the verticity was wholly destroyed, or rather much confused; for Mr. *Derham* found by drawing along one of the poles of the load-stone near the sides of the wire, that in some places it would attract, in others repel, and so attract and repel all along the wire; nay, Mr. *Derham* fancied, that in some places, one side of the wire would be attracted, the other repelled by one and the same pole of the load-stone; these surprising chances do sufficiently shew, that the magnetic virtue is put into great confusion by the violence exerted upon the wire by twisting, which not only separates the fibres of the iron (as may be seen with the eye, but especially, when assisted with a microscope but likewise changes their situation from lengthwise to screw-wise: Mr. *Derham* then tried, what would be the issue of splitting or cleaving touched wires, particularly, whether they would exert the same effects, that magnets are said to do, when sawn in two meridianally; of which Dr. *Ridley*, in his *Treatise of magnetical Bodies and Motions*, Chap. 9. says; "Cut a piece from a magnet meridianally, and that extremity, which was placed south, when it was whole, being severed, will turn north, tho' at first it was naturally the south point." But Mr. *Barlow* is of a contrary opinion, and says, "That the poles of such a piece of magnet, when severed, will abhor the same poles, to which it grew in the whole magnet;" but he subjoins in his *magnetical Advertisements*, Ch. 2. "But here you must beware of an error, which some have fallen into, who observing the above-mention'd.

" discord, erroneously suppose, that, if both these magnets, the
 " larger and the smaller, *i. e.* the piece cut off, were conveniently
 " placed to swim in water, the smaller would not point with
 " its extremity to the south pole of the earth, as it did in the
 " magnet when entire, and when it was a part of the true north
 " extremity, but would point contrarily; there is, says he, no
 " such alteration; but that both the large and small ones, and the
 " like, cut meridianally one from another will absolutely point
 " the same way, which the entire stone did; only, the meridian
 " will be somewhat removed, &c." Dr. *Gilbert* is as express as
 Mr. *Barlow*, for, lib. 2, ch. 2. speaking of a magnet divided, and
 shewing, how that the parts, which coalesced in the entire stone,
 do by separation repel each other, he says, " That what was the
 " north and south pole before, is such still; for says he, the ver-
 " ticity is not changed, as *B. Porta* wrongly asserts; and tho'
 " the poles when divided do not incline to each other; yet both
 " are directed towards the same point of the horizon:" How the
 truth lies between Dr. *Ridley* and the two latter authors,
 Mr. *Derham* cannot determine, having never cut a magnet in that
 manner; but, by the magnetic laws, as well as from the autho-
 rity of Dr. *Gilbert*, and Mr. *Barlow*, he does not doubt, but that
 the latter is the truest opinion: In cleft wires the case is very sur-
 prising; oftentimes the poles are quite changed; so that what
 was the north, becomes the south pole of the wire in all respects;
 that is, not only turning, but also embracing, or avoiding the
 poles of the load-stone, as if it had received a new and contrary
 touch; sometimes one half of the wire will retain its magnetism,
 which it had before splitting, and the other half have it quite
 changed; sometimes no change at all will ensue, only the magne-
 tism be much weakened; as, indeed, it always is in all the experi-
 ments, where the wire is split; but generally, where one of the
 halves has suffered a change, and the other not, Mr. *Derham*
 observed, that it is the thinnest and weakest that has been chang'd
 and the thickest that retained its touch; sometimes, where one of
 the split halves has received an inverted verticity, or seems to have
 no verticity at all, one of its extremities will incline to one of the
 poles of the magnet, not according to its touch, but in an inverted
 order, and the other extremity be attracted indifferently by both
 the poles of the load-stone; and in some cases, that extremity
 shall be attracted by one pole, but be neither attracted nor repell'd
 by the other; but stand hesitating as it were, whether it had best
 fly to, or from that pole of the load-stone; only, if that pole of
 the

the magnet be too near, then that extremity of the wire will constantly fly thereto; as indeed, it is the nature of all magnets and magnetic bodies, to do, when they touch or approach very near each other, tho' they repelled before; the cause of these great changes in touched wire produced by splitting, Mr. *Derham* has sometimes imagined to arise from the violence exerted thereon by bending; but in some wires that he split, with very little bending one half had been utterly changed, and the other not; in other wires he split, by suffering the halves to bend as much as they would, no change has happened; and some others have suffered a total change; sometimes Mr. *Derham* imagined, that the splitting the wires in a north or south position, or beginning to split at the north or south extremity of the wire, first might be the cause of this contraversion of the poles; but upon trials he found there was little in any of this; there is one thing very surprising in split wire; viz. that the laying the one or the other side of the half uppermost, will cause a great alteration in its tendency, or aversion to the poles of the magnet, as he above observed; but upon laying the contrary side of that half uppermost, the extremity shall be attracted by one, and repelled by the other pole of the magnet; in other pieces, where the extremities are regularly attracted or repelled only in an inverted order, as if new touched, if it lay with the round side uppermost at that time, and be then turned upside down, viz. the flat cleft side uppermost, it is ten to one, if one of the extremities be not either attracted by both the poles, or repelled by both; or else be attracted or repelled by one, and hesitate as to the other; for, so it often happens: The cause of this lubricity of the magnetism, Mr. *Derham* imagined, might be, because, the sides or edges of the wire had received contrary poles by splitting, and consequently, were turned topsy-turvy, that what was the north might then be the south edge of the half; but Mr. *Derham* could never discover, but that the sides of each extremity, or of any other part were the same, when he held the load-stone to one or the other side; which he always did in every experiment for the greater certainty.

Mr. *Derham* tried the old experiment of touching wires, by rubbing them backwards and forwards with one of the poles of the loadstone; Mr. *Barlow* was the first that discover'd the error of this way of touching; viz. that it weakens much, or hurts the touch; this Mr. *Derham* tried and found, that it is not only true, but likewise that the reason thereof, is, because the poles of the wire, or needle so touch'd, are not at the extremities,

tics, but in or near the middle of the wire or needle; sometimes one is near the centre, the other at one or both extremities; for in some wires so touch'd, both its extremities would be attracted by one pole of the load-stone, and repell'd by the other; and in such a case the repelling pole always found a sympathetic part near the center of the wire; in others (especially, wherever the verticity succeeded, as sometimes it will do, and that pretty strongly too) the verticity would be inverted, and the extremities of the wire attracted and repell'd in a direct contrary manner to the natural form; the reason of all which will be manifest from these following experiments: Mr. *Derham* touch'd a wire from one extremity to the other, with only one pole of the magnet; this gave so vigorous a touch, that he is almost of opinion, it is the best way of touching; the consequence was, that the extremity where he began, always turn'd contrary to the pole that touch'd it; he again touch'd the same wire, and others too with the pole of the magnet, from the same extremity, and then that extremity turn'd the contrary way; e.g. mark one extremity of a wire for the north, and touch that wire, by drawing the north pole of the magnet divers times along the wire from the north to the south extremity; this wire so touch'd shall have a vigorous verticity, but the north extremity will stand south; but if you touch that, or another wire (for it is all one, because the latter destroys the former touch) by drawing the north pole of the magnet from the south to the north extremity of the wire, then this north extremity will turn north; and it will do the same, if you touch with the south pole from the north to the south: Mr. *Derham* further touch'd an iron wire exactly in the middle, with only one pole of the load-stone, without drawing it backwards or forwards; the event was, that in that place that pole of the wire was and the two extremities were the contrary pole of the wire, and were accordingly repell'd or attracted by the poles of the loadstone; and the middle, and an inch or more on each side, was attracted only by the pole that touch'd it.

A Roman Inscription; by Mr. Ralph Thoresby. Phil. Trans. N^o 303. p. 2145.

A Roman monument was discover'd at York in digging a cellar in *Coring Street*, not far from the Roman wall and *Mutangular Tower*, describ'd by Dr. *Lister* in a former *Transaction*; this monument, dedicated to the *Genius* or tutelar deity of the place, is not of that coarse rag, that generally the Roman monuments were made of, but of the finer grit, like the altar at the

the Lord Fairfax's house in York; it is 21 inches long and 11 broad, inscrib'd thus GENIO LOCI FELICITER: there was a larger stone found with it, but it had no inscription; nor was there upon either of them the representation of a serpent, or youthful visage; by both which the ancients sometimes represented these *Divi topici*: The author of this votive monument seems to have had the same superstitious veneration for the Genius of York, as those at Rome had for theirs, whose names they were prohibited to utter, or inquire into; hence it is, that upon their coins the name of this deity is never express'd, but in a more general manner by *Genius P. R.* or *Pop. Rom.* Mr. Thoresby had such a coin of *Constantius*, minted at London, as appears by the *Exerg.* LON. under the effigies of that deity, with a *Patera* in the right hand, and *Cornucopia* in the left inscrib'd GENIO POPULI ROMANI.

Mr. Thoresby instances in that of this Emperor (the father of *Constantine the great*) the rather because he made York his Imperial seat, and was deified there; the medal of whose apotheosis Mr. Thoresby also had, having been minted at the same place, and inscrib'd MEMORIA FELIX; as the Genius of the city of Rome was express'd by G. P. R. so was the Genius of the common-wealth from a most sordid flattery, by that of the emperor, who they pretended to be their happy Genius; Mr. Thoresby had one even of Nero's, not only after his *Quinquennium*, but also the year after he had laid most of the city in ashes; yet by the express order of the senate, inscrib'd GENIO AUGUSTI S. C; therefore some of the fathers have justly reproached the Romans, for paying a greater veneration to the Genii of their emperors, than to *Jupiter* their supreme God: This custom of deifying the Genii, and that of assigning God for the defence of particular cities, is very ancient, as appears by what the Prophet *Jeremiah* ch. ii. v. 28 and xi. v. 13 says of revolting *Judah*, according to the number of thy cities are thy Gods; after the manner of the heathens, who according to *Varro* (*Pool's Synopsis Critica. in loc.*) had above 30000; and yet, notwithstanding this prodigious number, it is evident from their medals, that several cities were sometimes assign'd to the protection of the same tutelar deity; thus the Greeks (from whom the Romans receiv'd this, and several other of their superstitions) committed both *Magnesia* and *Smyrna* to the protection of *Cybele*; medals of the former are more common, than those of the latter: Baron *Spanheim* has writ a learned discourse upon them, one of which Mr. Thoresby had in his *Museum*, with the effigies of that mother

mother of the gods with her towered head, and CMTPNΛ; upon the reverse was a lion passant, with CMTPNΛION; Mr. *Thoresby* had also a large curious medal of *Julius Philippus*, that might induce us to believe, that *Antioch* was also devoted to the same *Cybele*; for it had round her head with the turreted crown ANTIOKEON MHTPOKOΛON with Δ (or rather Λ) E and SC on each side of the head: Mr. *Thoresby* was somewhat at a loss about the meaning of the latter word, unless the Greek and Roman tongues began then to admit of a sort of mongrel mixture; so that from MHTHR and *Colonus* might proceed MHTPOKOΛONON; and thus the *Antiochians* had the title of the men of the mother colony; the ΛE which are in Greek, and SC in Latin characters, the former signify *Lustrum quintum*, the other *Senatus Consulro*, seem to countenance this conjecture, the Roman S being different from that in ΘΙΑΠΠΙOC and CEBACTOC upon the same coin. Mr. *Thoresby* had another medal of *Antoninus Pius*, inscribed BEPOIAION, mentioned *Acts* xvii. 2.

Roman Coins near Edlington in Yorkshire; by the Same.
Phil. Trans. N^o 303. p. 2149.

THESE coins were dug up at the east entrance of *Clifton*, a village on the cliff of the hill, three miles from *Doncaster*, the Roman *Danum*, where the *Præfectus Equitum Crispianorum*, resided, and a mile from *Cunsburgh*, or *Coninsburgh*, an ancient seat of the kings during the *Saxon* heptarchy; they were found so near the high-way, that the cart-tracks had worn the earth off the top of the urn, wherein they were contained; upon digging farther, there was found another *Theca Nummaria*, which was full of copper coins as the former was; both the urns were large and entire; the larger one might contain about two gallons; by the fragments (the urns themselves having been accidentally broken) they appeared to have been of a finer clay than those found at *South Holland* in *Lincolnshire*, and the coins were very well preserved, by being in a dry soil; of 60 Mr. *Thoresby* had of those found at *Fleet*, in the county of *Lincoln*, there was not one before *Gallienus*, nor after *Quintillus*; and of near 150 found at *Clifton*, there was not one of an older date; so that both those in *Holland*, and those in *Yorkshire*, seem to have been hid in some common calamity, that followed the death of that short liv'd emperor *Quintillus*, who reigned but 17 days, *A. D.* 271. And within six years after we find, that *Probus* the emperor, upon some commotions in *Britain*, sent over some *Vandals* and *Burgundians*

gundians, who had invaded *Gaul*, to inhabit *Britain*; upon whose arrival, probably, such as had made the insurrection, might conceal their treasure, and being slain in the conflict, it lay hid 'till now; this Mr. *Thoresby* looks upon as a more probable conjecture, than the persecution of *Dioclesian*, which was not till 34 years after. The following capital letters are upon the coins, the rest are only for explanation; the reverses of *Galienus's* coins were, SECURITAS PERPETUA PAX AVGVSTI APOLLINI CONSERVATORI AVGVSTI PUDICITIA. LAETITIA AEQUITAS AVG. AETERNITAS AVG.

LIBRO Patri CONS. AVG. DIANAÆ CONS. AUG. MARTI. PACIFERO P. VII. COS. (*Pietas libans*) S. STATOR, which Mr. *Thoresby* takes for *Mars*, who is sometimes so stiled, as well as *Jupiter*. VICTORIA AETERNA CONCORDIA.

Reverse of *Salonina* Reversa VESTA.

Reverse of *Posthumus*, PAX. AVG. P. M. TRP. COS. V. which Mr. *Thoresby* takes to be remarkable not having met with any more than the fourth consulship.

The reverse of *Victorinus*, INVICTUS (*Typus Solis vel Apollinis*) VIRTUS AVG. PAX AVG. SALUS AVG. PIETAS AVG.

The reverse of *Tetricus* the father, SALUS AVG. PAX AVG. HILARITAS AVG. VICTORIA AVG. FIDES MILITUM LAETITIA AVG. SPES PUBLICA COMES VIRTUS AVG. COMES AVG.

Reverse of *Tetricus Caesar*, SPES PUBLICA SPES AVGG. PIETAS AVGGUSTORUM.

Reverse of *Claudius*, GENIUS EXERCITIBERARITAS AVG. VIRTUS AVG. VICTORIA AVG. PAX AVG. FELICITAS TEMPORIS AEQUITAS AVG. JOVI VICTORIA.

Reverse of *Quintillus*, PROVIDENTIA AVG. VIRTUS AVG.

Balls voided by Stool; by Mr. Ralph Thoresby. Phil. Trans. N^o 304. p. 2164.

MADAM C by voided a ball, after such severe pains, that her life was in danger; the bulk of it was much short of another Mr. *Thoresby* had seen; and (as a Vol. IV. N^o 13. P P P further

further instance of the danger of swallowing fruit-stones) she immediately after, voided several plumb-stones, tho' she had not for a twelvemonth before eat any of that fruit: Captain *West* told Mr. *Thoresby*, that he had once seen two stones voided by one *William Coldel*, of *Green*, larger than any of those three formerly mentioned in *Phil. Trans.* N^o 281, 282; the smaller stone was somewhat larger than the biggest of those, and the other was surprisngly large, being not much unlike the shape of the *Echinus* shell, or helmet-stone, flat on one side, and round on the other; it was above six inches in circumference one way, and seven the other; they weighed nine ounces, when first evacuated, and were removed by a diet-drink with an *Alkali* powder, and a magisterial stomach-plaister; the person died seven years after, of a ball too large to be evacuated; and upon feeling it betwixt the *Hypocondrium* and share-bone, it seemed to be as large as a goose-egg.

Several Experiments on the Attrition of Bodies in Vacuo, and a Description of a Machine for giving a swift Motion to Bodies in Vacuo; by Mr. Hawksbee. Phil. Trans. N^o 304. p. 2165.

A A Plate XIII. Fig. 11. represents a ladder, such as is generally used in houses; B B a bar of iron which passes thro' the middle of the upper step, and is fastened to the back-board of the ladder, by two nuts and screws both thro' the board and iron; C C the jaws of the iron-frame, which holds the large wheel D D of 23 inches diameter within its groove; E E the brass-plate of the air pump, on which the recipient *ff* is placed; *gg* the spindle to which bodies of different magnitudes may be fastened, by a hole passing thro' their middle, sufficient to receive their spindle; and by means of the two nuts *h h*, a larger or a smaller body may be screwed fast between them; *i i* a brass-plate turned true to the ground edge of the recipient, whereon it is placed, having a brass box in the middle of it, which is full of collars of leather well oiled, thro' which the spindle passes; the hole in the brass being also exactly fitted to receive it; *k k* two pillars with nuts to screw down a piece of board, which has an iron fastened to it to receive the upper point of the spindle, the lower one falling into a brass socket, screwed to the middle of the plate of the air-pump; *l l* the supporters reaching from the upper-board of the ladder to the pillars, to prevent the recipient being drawn out of its place by the motion and tug of the wheel-band; *m m* the small wheel which the band surrounds from the large

large one, being one inch and a half in diameter; *nn* the winch which gives motion to the whole; the small wheel *mm* making about 15 revolutions to one of the large wheel *DD*; so that a body fastened to the spindle *gg* of the small wheel *mm* must be turned 15 times round to one revolution of the large wheel; and according as it shall exceed the small wheel in diameter, so will the velocity of the motion of the extreme parts be proportionably increased; *oo* are two screws which fasten the ladder to the floor.

Exp. I. Shewing that light is produceable upon a swift Attrition of Amber on woolen in Vacuo.

Mr. Hawksbee being provided with the machine above described, for giving a swift motion to bodies *in Vacuo*, the amber made use of was beads, about the bigness of small nutmegs, and threaded, by which means they were put upon a piece of wood, which he had caused to be turned on purpose, with a groove on the edge thereof, to keep the beads from being displaced upon a smart attrition; and likewise, between every bead there was a string tied over from pin to pin, which were so many pieces of wire, drove thro' the wood for their better security, the beads appearing about half their diameter beyond the wood to which they were fixed, as represented in Fig. 12. In this manner it was put upon the spindle, and fastened there by the two nuts, as above-described and as represented Fig. 13. Then the brass-plate whereon the woolen was wrapt, being screwed to its place (by means of the socket, which receives the lower extremity of the spindle) would then spring back, and lay hold of the amber with a moderate force, as in Fig. 13. Being thus prepared and the receiver placed over it, with its upper plate and box for the spindle to pass thro', the pump was set on work, and in a very little time the mercury in the gage was elevated to about 29 inches and $\frac{1}{2}$ which shewed that the recipient was well exhausted; the large wheel being then turned gave a very swift attrition to the amber on the woolen, but there appeared no light at first; yet in a second or two of time it became visible enough, which shews that it requires some degrees of heat to produce the phenomenon; Mr. Hawksbee could not observe, that the continuance or increase of the motion, contributed any thing to the enhancement of the light, after its first production; nor would the light thus produced, live on the amber to continue a circle, notwithstanding the velocity of the motion communicated; but died as soon as it had deserted the fricated woolen; however the light continued

without intermission, and was discernible at the distance of three or four foot upon the woolen during the motion, where the attrition of the amber was made; what was further observable, in this experiment was, that it very strongly confirms those made on the production of heat *in Vacuo* by attrition; for the amber was not only moderately heated, but appeared to be burnt and cracked by its intenseness; and likewise the woolen against which it rubbed, not only appeared discoloured, but perfectly scorched and burnt thro'; that tho' the same motion and attrition was given the amber in the open air, yet very little light ensued, in comparison of its appearance *in Vacuo*; that the velocity of the extreme parts of the amber, was equal to something more than $\frac{1}{4}$ of a mile in a minute; supposing the large wheel, whose diameter is 23 inches, to make two revolutions in a second of time; the diameter of the small wheel moved by it one inch and $\frac{1}{4}$; and the diameter of the wood and amber on the same spindle with the small wheel, four inches and $\frac{1}{4}$.

Exp. II. *Shewing the necessity of the presence of the air, at least some degree thereof, in the production of fire, upon the attrition of a flint and steel.*

Mr. Hawksbee having provided a steel ring about four inches diameter, and $\frac{1}{4}$ of an inch thick, which he fixed between two pieces of wood of a less diameter, on the spindle with the nuts, as mentioned in the foregoing experiment, its edge verging about $\frac{1}{4}$ an inch beyond the extremity of the wood, that held it; the brass-plate, which he made use of for fastening the woolen for the attrition of amber, served likewise to fix a piece of flint, an edge of which stood exposed to the steel, whilst the brass-plate by its spring held the flint pretty strongly to it, notwithstanding some might be worn or chipped off by the rapidity of the motion; in this manner it was covered with a receiver, a brass-plate and box, as the former; but before any air was exhausted, the large wheel was turned, which gave motion to the small one, and consequently to the included steel, which exhibited sparks of fire in a very plentiful manner; after some air had been exhausted, the large wheel was turned as before, but the number of sparks then produced, did not only seem to be lessened, but a sensible decay of their lustre and vigour was evident; and so at every stop that was made, to repeat the experiment at greater rarefactions, the sparks produced still diminished in their quantity and light; till at last, when the receiver had been well exhausted, then tho' a more violent motion was given the steel than before, yet there did not appear the least spark to be struck from it; but
a small

a small continued light was visible on the edge of the flint, that was rubbed by the steel; upon admitting a little air, some sparks upon the motion given, were discovered to be of a dull gloomy hue; but upon admitting a little more air, and by some accident the whole quantity being insinuated, and then upon the repetition of the wheel's motion, the sparks appeared as numerous and as vivid as at first.

Exp. III. *Shewing the production of a purple light, upon the attrition of glass on woolen in Vacuo; together with the various Phenomena of the same experiment at several trials, &c.*

The glass Mr. Hauksbee used in this experiment was globular, about four inches diameter, having a passage thro' the middle to receive the spindle, to which it was fastened with corks and a screw; the woolen against which it was to rub, was such as is commonly sold for gartering, the coarser sort of which Mr. Hauksbee chose on purpose for its roughness, supposing it more likely to improve the phenomenon, than the list of cloth formerly used for the same purpose; this woolen was wrapped about the arm of the brass-spring, described in the former experiments, and being screwed down to its place, it gently embraced the glass globe; being thus prepared, and the large receiver put over all, the pump was wrought, and in a little time the receiver exhausted; then the large wheel being turned, gave 15 revolutions to the included globe, to one revolution of its own; in which swift motion, rubbing on the above-mentioned woolen, a fine purple light ensued, the included apparatus being distinguishable by it, and continued so during the attrition; upon admitting a little air, both the light and its colour diminished; and as the air was at several times permitted to re-enter the receiver, so the light became manifestly more pale, and less vivid; and even when the receiver was replete with air, a small faint light discovered itself upon the same attrition given, as at first; what was farther observable in this experiment was, that the purple light which appeared, seemed to be about the breadth of $\frac{1}{4}$ an inch, and about one inch high, being no where visible, but on each arm of the brass spring, where the glass in its motion rubbed on the woolen; and that the light remained steady, without the least undulation, notwithstanding the motion of the glass was considerably swift.

The first time Mr. Hauksbee made this experiment, its success was much the same, as he has just now related; but when he came to repeat it twice or thrice, with the same glass, no purple light appeared, a pale one then succeeding in its room; nor could

could he by any means recover it, till he had taken a new glass, which after he had used for the same purpose two or three times, the success was the same with the former, nor could it be revived again, without a new one; in this experiment, it was sometimes observable, that the glass when taken out after a violent attrition would be so hot, as that a person could not hold it in his naked hands without a sensible offence; that the woolen on which it rubbed, appeared not only discoloured, but sometimes perfectly burnt thro'; it would sometimes happen in making this experiment, that a light would be carried quite round the glass globe, thereby forming a continued circle, during its motion, notwithstanding it touched the woolen in no more places, than in the former experiments; at other times, a perfect halo would be seen round the stagnant light; which Mr. *Hauksbee* supposes, might have proceeded from some drops of water, that will sometimes insinuate by the spindle thro' the box, on the upper brass-plate, where water was always kept, to prevent the admission of any air; the water descending on the spindle till it reached some more extensive part, would there by the violence of the motion given, be thrown about the receiver in small drops, some of which were likely to fall on the woolen, where being heated by the motion of the above-mentioned glass, it evaporated, appearing like a halo around the light; for after Mr. *Hauksbee* made a contrivance, to prevent the scattering of the water, no such appearance happened: Sometimes, Mr. *Hauksbee* observed the light to break from the agitated glass, in as surprising a form as lightning; particularly, when he used some list of cloth, that had been drenched in spirits of wine, and fastened to one arm of the brass-spring, and some of the same list that had been steeped in water, impregnated with salt-petre, tied on the other arm; but both pieces of list had been very well dried, before he made use of them: At another time, Mr. *Hauksbee* made use of two flat shells of oysters well dried, instead of the woolen for the attrition of the glass, and each arm of the brass spring had one fixed to it; upon the usual motion given the glass *in Vacuo*, a light appeared resembling a fierce flaming spark, just where the glass and shells touched each other; the light did not seem to extend itself, but was contained in a small compass; he tried next, what would ensue upon the attrition of woolen on the above-mentioned shells *in Vacuo*, and the success was, that a light was produced, but it appeared very dim and gloomy, at best like a faint halo: In order to try in what degree the woolen might contribute to the *Phænomena* in the foregoing experiments, Mr. *Hauksbee* took
some

some of the above-mentioned list, and bound it about the edge of a wooden wheel he caused to be turned for that purpose; he fastened as usual, the wheel with its woolen edge, on the spindle, and the same gartering was made use of upon the brass spring, as in the first experiment; these being put together (as in all the other experiments) and the receiver exhausted, the large wheel was turned, and upon the attrition of the woolen cloths, a small glimmering light succeeded; but the continuance of the motion gave no encouragement to hope for any increase of it; Mr. *Hauksbee* expected to have found the woolen cloths at least discoloured, upon their friction, which was sometimes considerable; but on the contrary, there did not appear the least sign of any such thing; the light entirely disappeared, upon the re-admission of less than $\frac{1}{4}$ of the recipient's natural contents of air, so the attritions then made was as great as it had been at any time before: Mr. *Hauksbee* could not discover, that the various colours of woolen, contributes any thing to the different colours of light, exhibited in any of these experiments.

Exp. IV. *Shewing the production of a considerable light, upon the attrition of glass on glass in Vacuo and in common air.*

In this experiment Mr. *Hauksbee* made use of a globular glass, about three inches diameter, fixed on the spindle, as in the last, and to the two arms of the brass spring were tied two slips of thin board, to each of which were first fastened two pieces of a glass-tube, by putting some small nealed wires thro' their cavities; which wires likewise passing thro' some holes made in the board for that purpose, kept them tight in their places, as represented by Fig. 4. In this manner being covered with a large receiver, and fitted in all respects, as usual, the pump was wrought, which in a little time had exhausted the air therefrom; then upon turning the large wheel, a swift motion was given the included glass, whereby rubbing upon the above-mentioned tubes, a considerable light was exhibited; so that the whole included apparatus became perfectly distinguishable by it, and would have been much more so, had not the day-light prevented, it being then but very little after five P.M. a clear horizon, and the experiment made in an open room; the colour of the light produced, resembled melted glass, not only where the friction was made, but likewise seemingly at the extremities of the tubes A B where the globe in its motion did not touch them: What was further observable in this experiment was, that upon re-admitting the air into the recipient at several times, at each time
a mo-

a motion being given, as at first, there appeared no sensible decay of light; till at last, when the tubes by much attrition were warm, and consequently lessened in their spring, the light (in proportion to the abatement of their force on the moving body) was diminished; as Mr. *Hauksbee* had often observed, when the motion had been made for some small time, only *in Vacuo*, or in common air; and had the experiment been begun, where it had finished, a lesser quantity of light (from the above-mentioned cause) would then have been exhibited *in Vacuo*; hence it follows, that the different mediums did no ways contribute to the augmentation or diminution of the light produced, but it seems to proceed entirely from the weakening of the spring, by the wear of the bodies, which is caused by the violent attrition of the one upon the other in either medium: Mr. *Hauksbee* did not find that the polish or glaze on the outside of a glass, adds any thing to the light, having produced the same effect by a glass much worn by often using: Mr. *Hauksbee* repeated the same experiment in a clear day about noon; and the success was that the light then produced *in Vacuo* was as sensible to the sight, as a piece of red hot glass of the same bigness, would in the same time have appeared in the open air; but tho' the appearance is such, it is no longer so, than the motion is continued; hence it is to be observed, that tho' it seems to be of the colour of red hot or melted glass, yet it is not really so; for if it were, it must of necessity outlive the motion some little time, which he could yet never discover in the darkest night.

Exp. V. *Shewing the production of light upon the attrition of glass on glass under water.*

This experiment was no more than a repetition of the last, saving only, that the included *apparatus* was entirely covered with water; from the surface of which when the air came to be exhausted, and the large wheel turned as usual, it was easy to discover a pretty brisk light, upon the first motion of the included glass globe on the tubes, illuminating the whole body of the water; the parts of the tubes, where the friction was made by the globe were distinguishably red; but they were soon lessened in their appearance, and in a little time were extinguished; the water by the continuance of the motion, approached nearer and nearer to the colour of whey, and at last became so thick, with the grit and powder produced by the attrition of the glasses, that the light could then be, but just discovered thro' its body, and that not constantly, but like faint flashes at a distance; Mr. *Hauksbee* had made this experiment, when it appeared more
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luminous than it did at this trial; and he observed thro' a good microscope the powder produced from the attrition of the glasses; but he could not discover with the greatest attention, that the parts were any ways melted, only they appeared of a long slender figure.

A Puppy that received no nourishment by the Mouth; by Mr. Samuel Brady. Phil. Trans. N° 304. p. 2176.

THIS puppy was whelped at its full growth, having no appearance of a mouth at all, and it lived some time after it was littered; when the skin was pulled off the head, there did not appear the least passage thro' it; the head was one entire solid bone, without sutures, somewhat round like a man's skull, with a little prominence on the fore-part, resembling the *Os nasi* of a man, but without any aperture; it had no place for eyes, nor *Meatus* for ears, only the outward resemblance of one on each side, unpenetrated, and placed lower than naturally; there was no jaw-bone, nor conveyance to the top of the *Larynx* and *Pharynx*, but from thence downwards all was natural: This, Mr. Brady takes to be a confirmation, that the nourishment of the *Fœtus* in the *Uterus* is performed by the umbilical vessels only, without the assistance of the mouth.

An Account of an extraordinary Sleepy Person; by Dr. Oliver. Phil. Trans. N° 304. p. 2177.

ONE Samuel Chilton of Tinsbury near Bath, a labouring man, about 25 years of age, of a robust habit of body, not fat, but fleshy, and of a dark brown hair, happened on the 13th of May 1694, without any visible cause, to fall into a very profound sleep, out of which he could by no means be roused by those about him, till after a month's time; when he rose of himself, put on his cloaths, and went about his business of husbandry as usual; he slept, eat, and drank as before, but did not speak a word, till about a month after; all the time he slept, victuals and drink stood by him, which were spent every day, and as was supposed, by him, tho' no person saw him eat or drink all the while; from this time he remained free from any drowsiness or sleepiness, till about the 9th of April 1696, when he fell into his sleeping fit again, as he had done before; after some days his friends were prevailed on to try what effect medicines might have upon him; and accordingly, one Mr. Gibbs an apothecary bled, blistered, cupped, and scarified him, and used all the external irritating medicines he could think of; but all was to

no purpose; and after the first fortnight, he was never observed to open his eyes; victuals stood by him as before, which he eat of now and then; but no body ever saw him eat or evacuate, tho' he did both very regularly as he had occasion; and sometimes, they found him fast asleep with the pot in his hand in bed, and sometimes with his mouth full of meat; in this manner he lay about 10 weeks, and then he could eat nothing at all; for his jaws seem'd to be set, and his teeth clinched so close, that with all the art they used with instruments, they could not open his mouth, to put any thing into it to support him; at last, observing a hole made in his teeth by holding his pipe in his mouth, they now and then, poured some tent into his throat thro' a quill; and this was all he took for six weeks and four days, and of that not above three pints or two quarts; he had made water but once, and never had a stool all that time: On the 7th of *August*, which was 17 weeks from the 9th *April*, when he began to sleep, he awaked, put on his cloaths, and walked about the room, not knowing he had slept above a night; nor could he be persuaded he had lain so long, 'till going out into the fields, he found every body busy in getting in their harvest; and he remember'd very well, when he fell asleep, that they were sowing their barley and oats, which he then saw ripe and fit to be cut down: There was one thing observable, that tho' his flesh was somewhat wasted with lying so long a-bed, and fasting for above six weeks, yet a certain gentleman assured *Dr. Oliver*, that when he saw him, which was the first day of his coming abroad, he looked brisker than ever he saw him in his life before; and upon asking him, whether the bed had made him sore, he assured this gentleman, that he never found that, nor any other inconveniency at all; and that he had not the least remembrance of any thing that passed, or was done to him all that while; so that he went again to his husbandry, as he was wont to do; and remained well from that time, till the 17th of *August* 1697, when in the morning he complained of a shivering and a coldness in his back; he vomited once or twice, and that same day he fell into his sleeping fit again: *Dr. Oliver* going to see him, found him asleep, with a cup of beer and a piece of bread and cheese, upon a stool by his bed, within his reach; the *Dr.* felt his pulse, which at that time was very regular; and he also found his heart beat very regular too, and his breathing was easy and free; the *Dr.* only observed, that his pulse beat a little too strong; he was in a breathing sweat, and had an agreeable warmth all over his body; then the *Dr.* put his mouth to his ear, and called him as loud as he could several times by his name, pulled him

him by the shoulders, pinched his nose, stopped his mouth and nose together, as long as he could without choaking him, but to no purpose; for, all this time he did not give the least sign of his being sensible; the Dr. lifted up his eye-lids, and found his eye-balls drawn up under his eye-brows, and fixed without any motion at all; then the Dr. held under one nostril, for a considerable time, a phial with spirit of *Sal Armoniac*, extracted from quick-lime; then he injected it several times up that same nostril; and tho' he had poured into it about half an ounce of this fiery spirit, it only made his nose run, and his eye-lids shiver and tremble a very little; the Dr. finding no success with this, crammed that nostril with powder of white hellebore, and staying some time afterwards in the room, to see what effects all these together might have upon him; he never gave any sign that he felt what the Dr. had done, nor discovered any manner of uneasiness, by stirring any one part of his body, that the Dr. could observe; and after all these experiments the Dr. left him, being pretty well satisfied, that he was really asleep, and no sullen counterfeited, as some people supposed: Upon the Dr's relating what he had observed, several gentlemen from *Bath* went out to see him, and found him in the same condition the Dr. had left him in the day before, only his nose was inflamed and swelled very much, and his lips and the inside of his right nostril, was blistered and scabby, occasioned by the spirit and the hellebore; about 20 days after the Dr. had been to see him, Mr. *Woolmer* an apothecary, finding his pulse pretty high, drew about 14 ounces of blood from his arm, tied it again, and left him as he found him; and Mr. *Woolmer* assured the Dr. that he never made the least motion in the world when he pricked him, nor all the while his arm was bleeding. Several other experiments were made by such as went to see him from *Bath*, but all to no purpose: The Dr. saw him again the latter end of *September*, and found him just in the same posture, lying in his bed; but now his pulse was not so strong, nor had he any sweats, as when the Dr. saw him before; he tried him again, by stopping his nose and mouth, but to no purpose; and a gentleman ran a large pin into his arm to the very bone, but he gave no signs of his being sensible of what was done to him; in all this time the Dr. was assured, that no body had seen him either eat or drink, tho' they endeavoured it as much as possible; but that it always stood by him, and they observed, that sometimes once a day, at other times once in two days, all was gone; it was farther observable, that he never souled his bed, but always went to the pot: In this manner he

lay till the 19th of November, when his mother hearing him make a noise, ran immediately up to him, and found him eating; she asked him, *How he did?* Very well, he said, *thank God*; she asked him again, *Which he liked best, bread and butter or bread and cheese?* He answered, *bread and cheese*; upon this the woman overjoyed left him, to acquaint his brother with it; and both coming straight up into the chamber to discourse him, they found him as fast asleep again as ever, and they could not by any means awake him; from this time, to the end of January, or the beginning of February, he did not sleep so profoundly as before; for when they called him by his name, he seemed to hear them, and become somewhat sensible, tho' he could not make them any answer; his eyes now were not shut so close, and he had frequently great tremblings of his eye-lids, upon which they expected every day when he would awake, which did not happen till about the time mentioned; and then he awaked perfectly well, remembering nothing that happened all the while; it was observed, that he was very little altered in his flesh, only he complained, that the cold pinched him more than usual, and so he presently went to husbandry, as at other times.

Some Roman Inscriptions found at York; by Mr. Ralph Thoresby. Phil. Trans. N^o 305. p. 2194.

THERE was found in *Trinity Yard* in *Nickle-gate*, at *Tork*, a funeral monument, upon which under the statue (in *Basso Relievo*) of the standard bearer of the 9th legion, was the following inscription.

L DVCCIVS
 • *Lubens voluit* • L VOTL RVFI-
 NVS VIEN
 SIGN F. LEG. VIII.
 A N. XXIX.
 • *Hic situs est* • H. S. E.

This is an undeniable proof, that the 9th legion was not only in *Britain* in *Galba's* time, and that it was also called *Hispaniensis* (as appears from *Sir Henry Saville's* notes at the end of his edition of *Tacitus*) and likewise that it, as well as the 6th and the 10th legion, was called *Vindicta*, and that it resided at *Tork*, which had not been observed before; and yet both is evident, from the following inscription upon a *Roman* brick found there.

LEG.

LEG. IX. VIC.

This is also an argument of the tranquillity these parts enjoy'd at that time (possibly the latter end of *Severus's* reign) making bricks, casting up highways, &c. being the usual employment of soldiers at such vacancies.

Sir Henry Saville was of opinion, that this *Nona Hispaniensis in Britania*, was one of those established by *Tiberius*, *Cæsar*, or *Claudius*, or perhaps, in the latter end of *Augustus's* reign; but, however, that it was certainly here in *Nero's* reign, and that *Petilius Cerealis* was then lieutenant thereof, is indisputably evident from *Tacitus* lib. XIV. cap. 40. who gives a lamentable account of the slaughter of 70000 citizens and confederates, by the enraged *Boadicea*, in which number was all the foot of this legion; *Cerealis* with the horse hardly escaping; that this number is frequently writ by the *Romans* VIII, as well as IX, one that is but competently versed in their coins or inscriptions, cannot but have observed instances of both kinds; Those who have writ about the *Roman* legions, have said nothing about the place of residence of this 9th legion; only, *Urfatius* in his book *De notis Roman.* remarks, that it must be somewhere in *Britain*, because *Tacitus* tells us, that when the colony at *Camalodunum*, was destroyed by *Boadicea*, *Petilius Cerealis*, legate of the 9th legion, came to their assistance; but yet, he makes no mention of its being stiled *Victrix*.

Observations on the Seeds of several East India Plants; by *M. Leewenhoeck*. *Phil. Trans.* N^o 305. p. 2205.

THE *Euwane* is a tree in the *East Indies*, much about the bigness of an elder-tree, whose flower, scent, and figure are not very unlike it; but the branches are armed with thorns: It is used inwardly by none, excepting some women, who differing with their husbands, take it in order to kill themselves, it being an infallible poison; when these women have taken such a resolution, they take half a handful of the leaves of that tree, and boiling them in water, they put to it a certain oil, which they call *Sinselen*, and so they drink or eat it up; half an hour after which, they perceive a kind of convulsion in their head, and they vomit or retch four or five times; at last, they lose their senses, and foaming at the mouth, they fret and speak like fools or mad-folks, 'till they die; so that it seems, that the poison thickens the

the humours or fluid parts of the body, till their circulation quite ceases; some end their lives in one, others in two or three days, according as they have taken more or less of those leaves: The seed of this tree is mostly of a triangular figure, and where it is broadest it is not above the twelfth part of an inch; Mr. *Leeuwenhoeck* took a little of it, and putting it into a clean piece of paper, he bruised it with a hammer, and after that, he put it into a little glass phial, and poured some fair rain-water thereon, till it stood half an inch above the seed; after the seed had been infused in the said water some hours, he took a little of the water and mixing it with some of his blood, he immediately observed, that the blood was very much coagulated; yea, more than he had ever seen it in his life-time; it is true, blood when mixed with common-water, retains its clear red colour, and a great many globules (which are the cause of its redness) being dissolved in the water, do incorporate themselves therewith, in such a manner, that a person cannot distinguish any of them from the water itself, which thereby acquires a fine crimson colour; yet, the appearance was quite otherwise with the blood that was mixed with the seed water; for, the particles or globules thereof being coagulated, assumed a blackish or dirty colour; and tho' he observed, a very great number of blood globules that had not coagulated, yet they lay like stiff particles; nor could he perceive, that any one of them was dissolved or united to the water; so that there was not the least redness, that looked like blood, communicated to the water, nor did there break forth the least air-bubble out of this mixed liquor: M. *Leeuwenhoeck*, moreover, took a little of the said water, that was inclinable to a reddish colour, and dropping it upon six several places of a glass-plate, in order to observe what salt particles might be coagulated therein; he observed, in the said liquor, most of which did evaporate, that, besides the salt particles, there remained a great deal of a coagulated matter, wherein he could discover no figure; he likewise perceived, a great many exceeding small particles, which were mostly of an exact square figure, and some few were oblong squares, with four right angles; some of these salt particles were broad in the middle, and pointed at both extremities; but where a great many of them were coagulated together, their figures were irregular; he likewise observed, that where the water had lain a little time together, it was not entirely exhaled, but left a balsamic matter behind it: M. *Leeuwenhoeck* put some of the *Euvane* seed into water, in order to soften the skin thereof, that he might dissect it the more easily; and having accordingly opened several of them, he took out

out the plant, in which tho' it was no bigger than a small grain of sand, he could perceive two leaves, and that part of it, which was to be the root and body of the tree: The oil of *Singelan* or *Singely* is esteemed by the natives a good softner, and given to women in child-bed, and to other persons in pain, as also, to children, with or without any other ingredients; M. *Leewenhoeck* had a little of the seed of it, which is about the bigness of the *Eurwane*-seed, but somewhat longer; he moreover, had some few seeds called *Canfie*; this seed is used by the *Mahometans*, after being ground small and infused in water, and will intoxicate them, as much as wine does others; if a person that is not used to it, should take but 10 or 20 grains, it would have the same effect as if he drank ten bottles of wine; they say, that it makes them very stout and luxurious; but such as use it daily, and too often, bring themselves at last to one or two ounces; but then it will have the quite contrary effect, rendering them dull and doating, depriving them both of their memory and appetite, and at last, making them so lean, as hardly to have any flesh left upon their bones; and this is the use the *Moorish* kings make of it; for when they have a mind to be rid of some of their grandees, and would make them die a lingering death, they cause such a drink to be made, into which they also infuse the seeds of poppies, and give it them to drink twice a day, in prison, more or less, according as they would have them dispatched sooner or later; insomuch, that they shall live half a year or a whole year, without knowing any thing of the matter; they call this drink *Bosta*: This seed is little used by them in physic, tho' M. *Leewenhoeck* does not doubt, but that it might be well applied; because, it does not only imitate the effects of *Opium*, but also, if there is not too much of it used at a time, it has the same operation, as the best wine: This seed is about the bigness of hemp-seed, and it has likewise such another hard skin, so that one would be apt to take it for the same: M. *Leewenhoeck* took some of the *Canfie*; and stripping off the hard skin, and after that the thin membrane, that covers the plant, he observed, that the matter which lay within it, was as it appeared to him, nothing else but two leaves, together with the root and body of the plant; but upon separating these two leaves, he found, that they involved two other very small leaves, long and slender, and of the figure of the former; and he also discovered, that these small leaves had each of them four or five other small ones standing out above each other; from hence he concluded, that the tree or plant, which produces these leaves, is notched or indented; after-

afterwards, M. *Leeuwenboeck* took some common hempseed, and examining it a-new, to try whether he could discover any such small leaves, as he had found in the *Cansie*-seed, he observed, that all the parts of it agreed with the *Cansie*; at first, indeed, when he took the small leaves out of the larger ones, wherein they were folded, he could not see those indented parts above-mentioned; but, upon separating the leaves from each other, he could easily perceive them; and then appeared the two exceeding long leaves, lying so regularly within each other, that the indented parts could not be discovered; he bruised a few of these little *Cansie*-seeds, and poured rain-water thereon, in order to discover whether there were any salt particles in the same, and tho' he let some of the drops of this water stand several days together, it did not at all evaporate, but there remained a thick oily moisture, which he supposed was the reason he could discover so few salts coagulated; and those he observed therein, were very few, and of the same figure with the salts found in wine vinegar.

River and Land Shells, &c. found under Ground; by Mr. Morton. Phil. Trans. N^o 305. p. 2210.

UPON digging into a moorish pasture in *Nears Abbey-field* in *Northamptonshire*, there was found a few snail-shells of various kinds; about a foot deep they lay very thick, and digging downwards to about three foot deep their numbers increased; there were trials made for a considerable extent of ground, *viz.* about 250 foot in length, and 130 in breadth; besides, the same shells were thrown up in several places by the moles: What was principally observed in this search was; 1. A moist moorish black soil, in some places a foot and a half thick, in others somewhat above two foot; the lower half of it, was blacker and denser than the upper half, of a bituminous nature, and having all the signs of peat-earth; besides shells, there were found stalks, and leaves of grass, as also several kinds of other vegetables deposited, as it usual, in the like bituminous moors, in other parts of this island. 2. A white soil, as was supposed at first; but upon a closer inspection, it appeared to be nothing else than hay half wasted; as far as was dug into it, it was found every where copiously interspersed with shells; upon finding these shells under ground, Mr. *Morton* diligently searched this place, in order to find some of the like species living upon the surface, but he could meet with none of any kind whatever there; some of the fossile shells were the *Enavola* of land-snails, the

the rest of river or fresh water-snails; of the former there were the three following kinds. 1. A small *Buccinum* of five wreaths, or the *Buccinum exiguum quinque anfractuum*, Tit. 7. Lister in *Tractat. de Cochleis terrest. Anglic.* a kind which Dr. Lister observed to live in moss upon old garden-walls at *Estrope* in *Lincolnshire*; and Mr. Morton observed them at the mossy roots of old trees in several of the *Northamptonshire* woods, as also amongst moss upon the boggy sides of several standing springs. 2. A *Cochlea* of the compressed kind, but not so much compressed as some of them are; it had five wreaths, and a small circular *Sinus* in the center; this, if it is not the *Cochlea umbilicata*, &c. N^o 79. Lister. *Hist. Conchyl.* lib. I. has not hitherto been mentioned by any author, tho' common enough in the woods in *Northamptonshire*; Mr. Morton found a greater number of them (considering the compass of ground) inclosed in the earth, than ever he had done in any of the places, where they naturally breed. 3. The *Cochlea citrina*. Tit. 3. Lister *de cochleis terrest. anglic.* or the common striped snail-shell; but most of these in the moor were white, of the colour of the shells that have been dead a long time; Mr. Morton saw faint marks of their former stripes in some; most of the shells of this kind were lodged about four foot deep: He met with only two different kinds of river-shells. 1. A periwinkle-shell of three wreaths; generally less than the *Buccinum trium spirarum*. Tit. 24. Lister *de cochleis fluviatil. anglic.* There was a greater number of these deposited in the moor, than of any of the former kinds. 2. A periwinkle-shell of five wreaths, much smaller and more prominent than those of the *Buccinum longum sex spirarum*. Tit. 21. Lister *de cochleis fluviatil.* It is otherwise very like that *Buccinum* in the shape of its wreaths, but it has not been described by any author; there are of this kind some live shells found, in one of the *Northamptonshire* brooks, called the *Ise*: The moorish ground, wherein these shells lay deposited, extends from near the top to very near the foot of a hillock; upon the top and at the brow of this hillock, above the moor, there is a sandy soil of a reddish colour; the whole surface of the moor is level, conformable to the rest of the hillock, that is not moory, and of the same declivity with it, appearing to be in a natural and undisturbed state, as much so, as any of the glades in the neighbouring fields, excepting three or four trenches that have been cut thro' it.

It is evident, that these shells were left here at the general deluge, when those from the sea were also deposited on land, and not lodged since under deterrations from the higher grounds; for

then the upper parts of the moor must have been covered with a reddish sand, such as the higher ground is for the most part composed of; yet, nothing like that appears near the shells in this moor; besides, there are dug up here several shells, that in all likelihood never bred here, but were the inhabitants of a different soil; particularly, the striped snail-shell; for these animals have peculiar soils, and affect particular regions.

A very large Tumour in the Fore-part of the Neck, &c.
by Dr. James Douglas. Phil. Trans. N^o 305. P. 2214.

DR. Douglas had the opportunity of opening a woman, about 50 years of age, who had a very large tumour, or hard swelling, on the fore-part of her neck, possessing all the space between the whole extent of the lower jaw, and the upper part of the *Sternum*, with a considerable protuberance in its middle; laterally its point inclined to the left side, tho' the largest part of the tumour was on the right; the skin on the *Apex* of this protuberance was thin and shrivelled, of a different colour from the rest, and looked as if the swelling would have broke in that place; the skin was exceeding thin, having no fat under it; only, in a cavity between two lobes, on its right side, there was a small appearance of some fat; for the skin being less stretched there, the cells of the *Membrana adiposa* were not quite emptied; the fleshy fibres of the *Larissimus colli* were scarcely visible; the *Mastoidæus* and *Coraco hyoidæus* were exceeding thin, and in their ascent they adhered very closely to the subjacent tumour; the *Sterno hyoidæus*, and the *Sterno thyroïdæus*, that ran up the fore-part of this swelling, were distended so thin, that it was difficult to separate them, especially the latter, from it; the right carotid artery, in its ascent to the head, run along its outer edge, which increasing, did much obstruct the current of the blood that way; the internal jugular, the *par Vagum*, and the intercostal pair, in their descent to the *Thorax*, passed also over some part of this swelling; two of the lymphatic glands of the jugular vein were swelled as big as little eggs, being placed at some distance from each other, with an intermediate cavity, where there was found some fat; these two lobes made the tumour also very irregular on its right side; these muscles, the jugular, with the two glands adhering to it, and the rest of the above-named vessels being removed on both sides, Dr. Douglas observed, that this preternatural tumour seem'd to exceed the bulk of two fists joined together; its figure was almost triangular, with a broad basis under the chin, sloping a little on each side, as it descended to the upper part of the *Sternum*,

Sternum, where its point was pretty narrow; its surface was made irregular by reason of three protuberances, of which the largest was turned to the left side, the other two being placed on the right, as was above observed; it adhered by membranous filaments to the maxillary glands, to the *Diaphragm* and *Stylohyoidæus* muscles, under which, on the right side, a small portion of it in the shape of a nipple, intruded itself, as it were, under the tongue; in the upper and fore-part it also adhered to the *Os hyoides*; laterally it was connected with the *Levator scapulae*, and lower down to that part of the *Cucullaris* that terminates in the clavicle; backwards to all the fore-part of the *Aspera Arteria*, between its third or fourth cartilaginous rings, and the *Os pectoris*, as also to that muscle of the head called *Rectus internus major*, and to some part of the *Scaleni*; its lower part was engaged under the *Jugulum*, or lunated part of the breast-bone, to which it adhered; it was easily separated from its connections to all these different parts, but not so, from the *Glandula Thyreoidæa*, to which it adhered, after a very different manner; for where the thyroidal glands are joined to each other, a little below the *Cartilago cricoides*, on the fore-part of the *Aspera Arteria*, there was no separating it without cutting its substance; whence it plainly appears, that the union of these glands, was the origin of this excessive tumour; and yet, which was very remarkable, the glands themselves kept their usual figure, and were no larger than ordinary; this tumour was hard and very firm, being exactly of the consistence of a cow's udder, when boiled; yet, in a few places it was softish, containing a liquid and thick humour; its colour was chiefly of a whitish yellow, only in some places it was exceeding red, from its having a great number of blood vessels therein, and in others it was very white: In cutting this tumour, the Dr. heard the edge of his knife grate against something hard; wherefore, he carefully pared off all the soft part, and the hard substance that remained he boiled, and then cleared it very well, having left sticking to it at one corner, a soft cartilaginous body, which possibly, had the patient lived longer, would have acquired the same degree of induration; it very much resembled a piece of white unpolished rock-crystal; but whether it might be reckoned osseous, or whether it was rather the viscid humour of the glands hardened and concreted into this irregular chalky or gravelly substance, or whatever else it might be, the Dr. leaves it to others to determine: Dr. Douglas found in the *Prostate* of a very old man, a great many hard bodies, like white pease, of a substance exactly resembling this, only it was smoother on the outside;

some of these were in the body of the said glands, and others adhered by small roots to the muscular membrane, that invests them: The first appearance of this large swelling, was about 20 years before, occasioned by the breaking of a vein, as the patient used to express it, in a hard and very difficult labour; it increas'd but very slowly, not having arrived to any considerable bulk, 'till a few years before she died; it was never very painful, being a true *Schirrus*; several things had been applied unsuccessfully; its bigness became at length very troublesome, impeding her swallowing and free breathing, and at last it quite choaked her, by compressing the wind-pipe, upon which it lay; but besides this, the Dr. observed another remarkable accident, which much hastened her end, being very painful and troublesome for a year or two before she died; the *Uterus* was entirely schirrhous and distended to that degree, that it filled up the whole cavity of the *Pelvis*; part of the *Colon* and *Ileum* adhered so closely to it, that there could be no separation without tearing; both the *Ovaria* and *Tube* grew close to it; and indeed, the confusion and mixture of all these parts were so great, that if the *Ovaria* had not been swelled here and there with hydatidal tumours, he could not have distinguished them; the neck of the *Uterus* was pressed down so low, that upon a very gentle dilatation of the *Labia*, it offered itself to view, being exceeding hard, but yet smooth and regular, and so closely shut, that the Dr. could pass nothing without cutting; it had squeezed the *Vesica urinaria* so close against the *Os pubis*, that it could contain little or no urine, which obliged her to make it often, and that with pain; the pressure of this part backwards was so great upon the *Intestinum rectum*, that the evacuation of the feces had been obstructed for the space of five weeks before she died; the *Feces alvine* contained in the guts were but few, by reason she could not swallow any thing solid for a long time, and they were very hard, and in several distinct clots; there was observed to come away *per Anum*, for some considerable time, a great deal of *Pus* and slimy matter, but that proceeded from the *Uterus*; for, the acrimonious humour, which was wont to be discharged *per Vaginem*, having been pent up within its cavity, by the close constriction of the *Collum Uteri*, had corroded and eat its way thro' the substance of the *Uterus* into the *Rectum*, by which it was discharged; and this case Dr. Douglas has frequently observed in dissections; the thickness of the *Uterus* was near two inches, and in its bottom there was a great deal of this humour, white and thick, which made the extremities of his fingers white and rough, shrivelling the *Cuticula*, as if

if he had washed them with a strong solution of some acrid lixivial salt, and as happens to those who wash linen, from the caustic salt lodged in soap affecting their hands; it was very difficult to take the *Uterus* out of the *Pelvis*, by reason of its very close adhesion to the neighbouring parts.

A Glade of Light observed in the Heavens; by Mr. Derham. Phil. Trans. N^o 305. p. 2210.

AS Mr. *Derham* was observing the immersions of the third and fourth satellites of *Saturn* on the 20th of *March* 1706 in the evening, he observed a very surprising sort of light, in the constellation of *Taurus*, the lower extremity of which was below the bull's eye, and the other a good way above it, and that star about the middle of the lower extremity thereof; represented its appearance in Plate XIII. Fig. 16. this glade of light had the same motion, that the heavens had, and was much like the tail of a comet, but pointed at the upper extremity, as shewn in the Fig. Mr. *Derham* does not doubt, but that this light is such as Dr. *Childrey* first observed in *England*, and which *Cassini* and others afterwards, observed in *France*, as Dr. *Hook* says.

The Proportion of the Weight of Air, to the Weight of a like bulk of Water, without knowing the Quantity of either; by Mr. Hanksbee. Phil. Trans. N^o 305. p. 2221.

MR. *Hauksbee* having caused to be made a bottle somewhat of an oval figure, on purpose, that it might librate the more easily in water, that held upwards of three gallons; he put into this bottle as much lead as would sink it under the surface of the water, and it was, when weighed in that medium, ballanced by a small weight in the scale on the other extremity of the beam; Mr. *Hauksbee* included the weight, to prevent the inconveniency of bubbles of air, which he was aware would plentifully adhere to, and lurk in the irregular body of the weight, had it been fixed on the outside; being thus provided, and the bottle closed with common air, it was suspended by a wire at one extremity of a very good balance, and being in the water, it was counterpoised by a weight of 385 grains and $\frac{1}{4}$ in the opposite scale; being then taken out and screwed to the pump, it was in five minutes pretty well exhausted, the mercury in the gage being elevated to near 29 inches and $\frac{1}{4}$; it was then taken off the pump; but first, by turning a cock that screwed both to it and the pump, the air was prevented from returning into it; in this manner it

was

was put again into the water, and suspended as before on the balance, and it then weighed but 175 grains and $\frac{1}{4}$, which subtracted from the first weight, gave 183 grains the difference, and was the weight of the quantity of air exhausted from the bottle by the pump; then opening a cock under water, the water was at first violently impelled into the bottle (but gradually abating its force) till such a quantity had entered, as was equal to the bulk of air exhausted; so that by making the experiment after this manner, one need not be very solicitous in the nice exhaustion of the receiver; for it must answer reciprocally to the respective quantities exhausted, the remaining air being weighed at last, as well as at first; and no greater quantity of water could enter the receiver, than what would supply the space deserted by so much air; the bottle being now weighed again, it was found to be 162132 grains, from which subtracting 175 grains and $\frac{1}{4}$ (which is the excess of the weight of the bottle, above its like bulk of water) there remained 161956 grains and $\frac{1}{4}$, which being divided by 183 grains, the weight of the air exhausted from the receiver, gave the proportion as 885 to 1, the *Avoirdupoise* weights being brought to ounces, he reduced them to grains, by multiplying by 438, the precise number of grains contained, in an ounce of that weight; the column of mercury in the barometer was elevated at the same time to 29. 7 inches; this experiment was made in *May*, and Mr. *Hauksbee* does not doubt, but if it is repeated in *December* or *January*, there will ensue a sensible difference.

An Experiment, shewing that the seemingly spontaneous ascent of Water in small Tubes, open at both extremities, is the same in Vacuo, as in the open Air; by the Same.
 Phil. Trans. N^o 305. p. 2223.

MR. *Hauksbee* took three pieces of small tubes of different bores, and fixed them directly perpendicular in a piece of cork, with their lower orifices as exactly level as possible; he also fastened this cork to a wire, which passed thro' some collars of leather, included in a box on the upper plate of the receiver; by which means, he could at pleasure elevate or depress the tubes, without any danger of the air insinuating itself; being thus prepared, and tinged water being put on the plate, the small tubes, which had never been wetted, were drawn to the upper part of the receiver by the above-mentioned wire; and when the air was exhausted, the tubes were made to descend by the same wire, till their lower extremities were just plunged under the surface of the tinged

tinged liquor; upon which the water rose immediately in each of them, to a considerable height above its surface in the glass, and higher in the smaller tubes than in the larger ones, and would retain the quantity that spontaneously arose in them, notwithstanding their lower orifices were drawn out of the water; upon admitting the air again, they continued just the same as in *Vacuo*; Mr. *Hauksbee* found, that by plunging tubes of several sizes in the tinged liquor, so much of it would remain suspended in them, when taken out of the liquor, as in such tubes, when plunged, was elevated above the surface of the stagnant fluid; he likewise observed, that upon bending some small tubes, into the shape of syphons, by the flame of a candle, the orifice of the longer leg must be at least so far below the surface of the stagnant water, as that water in the same tube would spontaneously ascend therein, before it would run out.

A Roman Sudatory found at Wroxeter in Shropshire; by Mr. Thomas Lister. Phil. Trans. N° 306. p. 2226.

ABOUT 40 perches north of a ruinous wall, called the *Old-work of Wroxeter* (once *Uriconium*, a famous city in *Shropshire*) in a piece of arable land, a small square parcel thereof was observed to be barren, and not to be improved by the best manure, tho' these fields had formerly been made very fertile by the flames and ruins of the city; upon digging, there were discovered several bottoms of old walls (as are often found in those fields) in one of which, to the western corner of the said unfruitful spot of land, there was found a little door-place, which led into a square room, walled round, and floored under and over, with some ashes and earth therein: This as some suppose, was built in former times for a *Hypocaustum*, sudatory or sweating house for *Roman* soldiers, with four rows of small brick pillars, eight inches square, laid in a strong sort of very fine red clay, each pillar being founded upon a foot square quarry of brick, and upon the head of each pillar was fixed a large quarry of two foot square, almost as hard as flint, (as most of those *Roman* bricks are) and within as red as scarlet, and as fine as chalk; these pillars were to support a double floor, made of very strong mortar, mixed with coarse gravel, and bruised or broken bricks; the first of these floors was laid upon the large quarries, and when dry, the second floor was laid over that; but first there was a range of tunnel-bricks, fastened with iron cramps up to the wall within, having their lower extremities level with the under sides of the broad quarries, and their upper ends level with

with the surface of the upper floor; and each tunnel had two opposite mortice-holes alike, one on each side, cut thro' for a cross passage to distribute the heat amongst them all.

Wroxeter was one of the most considerable military stations or colonies the Romans had in this island; the city wall, as appears from a Survey taken of it by Mr. Lister, was not much less than three miles in circumference; and it is not improbable, but that it was founded by *Suetonius Paulinus*, or after, by *Agricola*, in their march to subdue *Mona*, now *Anglesey*; vide *Baxter's Glossarium Antiquitatum Britannicarum*: Sir *Christopher Wren* discovered the remains of such another *Hypocaustum*, as that near *Wroxeter*, when they were laying the foundation of the king's house at *Winchester*; Mr. *Hunter* gave an account *Phil. Trans.* N° 278. of an antiquity of this kind dug up in *Yorkshire*; Mr. *Lbwyd* in his additions to *Cambden* takes notice of another discovered at *Kaerbyn* in *Caernarvonshire*; and in the table of curiosities added at the end of the *Welsh* counties, N° 8. represents one of the hollow bricks or tunnels; Mr. *Cambden* himself mentions an *Hypocaustum* discovered at *Hope* in *Flintshire* in his *Britannia*. p. 688.

The Hypocausta of the Ancients; by Mr. Baxter. *Phil. Trans.* N° 306. p. 2232.

THE ancients had two sorts of *Hypocausta*; the one called by *Cicero*, *Vaporarium*, and by others, *Laconicum* or *Sudatio*, which was a large sweating-bath, in which there were *tria Vasaria abenea*, called *Caldarium*, *Tepidarium* & *Frigidarium*, from the water contained in them; the other sort of *Hypocaustum* is not so distinctly handled by antiquaries; it was a sort of a *fornax*, or kiln to warm their winter-parlours, or *Cenatiuncula hybernae*, erat & *Dieta*, sive *Cenatiuncula*, says *Argol* upon *Panvinus*, sub quâ ignis accendebatur, unde & *Cenatio Hypocaustum*; the *Cenationes aestivæ* & *hybernae* are mentioned by *Cicero* in his epistles; the terrace floor is called by *Vitruvius*, *Testudo*; *Testudines Alveorum in communi Hypocausti calefacientur*, says the same author; this *Hypocaustis* was called *Alveus* & *Fornax*; and the person that tended the fire *Fornacator*; the *Tubuli* seem to have been contrived to convey away the smother, that otherwise would choak the *Fornacator*; this kind of stove seems to be graphically described by *P. Statius* in *Balneo Hetrusci*.

— *Ubi languidus ignis inerrat
Ædibus, & tenuem voluunt Hypocausta vaporem.*

Of the terrace, *Argol* has these words, *Testudines sunt Pavimenta sub quibus Fornax ardet*; and by the bye, Mr. Baxter takes the word stove to be derived from *æstus*, quasi *æstuvium*.

The Jaundice occasioned by a Stone obstructing the Ductus communis bilarius, which was afterwards voided by Stool; by Dr. William Musgrave. Phil. Trans. N° 306. p. 2233.

MR. Harvey voided a stone by stool, which he said came from the *Ductus communis bilarius*; the figure of this stone was oval, almost an inch long, and its shortest diameter $\frac{7}{8}$ of an inch; it weighed 59 grains, when Dr. Musgrave saw it; but at its coming away it was above a drachm in weight, some part thereof being rubbed off by frequent handling; its surface was rough, unequal, and divided into several little eminencies, each somewhat less than the size of half a vetch: The several strong annular fibres, which appear not only at the orifice, where the *Ductus communis* opens into the *Duodenum*, but also all along the oblique passage (which according to Dr. Glisson is about half an inch long) of that duct, between the coats of the intestine, do by way of sphincter, keep this extremity of the *Ductus communis* very strait and close; and besides this straitness of the duct, the two oblique insertions it makes at some distance from each other, thro' the two outer coats of the *Duodenum*, render it still more difficult, for a substance of any bulk, to pass this way; so that, however large the stones may be that are generated in the gall-bladder, *Ductus cysticus*, *hepaticus* or *communis*, it is not easy to conceive, how a stone of the magnitude here described, could possibly thro' a passage of itself so very narrow, strait and difficult, be conveyed into the *Duodenum*: To prove that this stone was not formed in the alimentary duct, but (large as it was) had come into it from the *Ductus communis*, Mr. Harvey told Dr. Musgrave, that before the discharge of this stone, he had had the jaundice, which came suddenly upon him, and continued several months, in a severe and most excessive manner; that this jaundice, besides the discolouring of his urine and skin, to a very great degree, and besides loss of appetite, faintness, and several other symptoms, usual in this distemper, was also accompanied with a pain in, or near the stomach; that during this jaundice, his stools were of a white colour, as

having very little or no mixture of choler in them; that, going (under these circumstances, especially, with a continual pain, as before-mentioned) in his coach from *London* to *Clifton*, and soon after to the *Bath*, he found a little after his arrival there, that this stone came away by stool, and together with it, almost a spoonful of gravelly matter, and a considerable quantity of choler, as appeared from the yellowness of his stools; all which happened so soon after he came to the *Bath*, as plainly to prove, that the discharge both of the choler and stone, proceeded from the motion of the coach; that his deliverance from the jaundice, commenced from the time of the expulsion of this stone; for soon after that, the colour of his skin and urine, and indeed, all the bad symptoms disappeared; and in a very little time (weakness only excepted) he recovered.

All these things put together, make a considerable argument, that the orifice of the *Ductus communis* (how strait and how strong soever) was so far dilated in Mr. *Harvey*, as to give way to the stone, here described; that is, dilated to a circle $\frac{7}{10}$ of an inch in diameter, and one inch and $\frac{1}{2}$ in circumference: The jaundice is often observed to be a most stubborn distemper, not easily yielding to the most probable methods, and often to none at all; *Riverius* positively affirms, that when it proceeds from a stone obstructing the current of the choler, it is incurable, urging this reason for his opinion; *Calculus, cum dissolvi non possit, morbum facit incurabilem Cap. de Ictero*: When the jaundice is thus difficult of cure, especially, when there is a probability (whether from a pain fixed in, or near the region of the liver, or from any other good argument, whatsoever) that it arises from the cause now mentioned; it may not be amiss, to advise exercise on horseback, in coach, or any other such way, as shall be likely to dislodge the stone, and bring it off; but to make this exercise effectual, it ought to be as violent, as the patient can well bear; and in such a manner, as may by much agitation of the body, be most conducive to the designed cure; the account here mentioned, does sufficiently recommend this gymnastic course, as capable of relieving, in some cases of the jaundice, when the best methods of physic (for such no doubt Mr. *Harvey* had prescribed himself) fail of success.

An Eruption of Water in Craven; by Mr. Ralph Thoresby.
Phil. Trans. N^o 306. p. 2236.

MR. Thoresby having further enquired of a certain person who was an eye-witness of an extraordinary eruption of water in *Craven*, of which there is an account in Phil. Trans. N^o 245, was not only satisfied of the truth of the relation, but also, that a great part of the land still lay under sand and stones, tho' a great many had been employed to remove them; upon the opening of the rock, at the foot of which the town of *Starbo-
tham* stands, the water gushed out in so vast a quantity, as if it would have swept the whole town away; the waves came rolling down upon each other; several houses were quite ruined, and others up to the chamber-windows; one in particular was covered in such a manner, that a large piece of the rock was left upon the top of the chimney.

Observations of the solar Eclipse May 12 1706 at the Royal Observatory at Greenwich, &c. by Mr. Flamsteed. Phil. Trans. N^o 306. p. 2237.

THE morning was cloudy and moist, till about eight o'clock, when the clouds began to break, and the sun was sometimes seen thro' the intermediate spaces, a seven foot telescope was fitted up with a scene to receive the species of the sun, on which he appeared about seven inches diameter, divided into digits by six concentric circles; but clouds intervening, the sun frequently rendered this way of observing inconvenient, and therefore laying aside the apparatus of the scene, Mr. Flamsteed viewed him thro' the same telescope with smoak glasses, and observed,

1706	Time correct.
May 1st	by the pendu-
St. N.	lum clock.
MANE	

h.	'	"
8	21	30
	28	00

A very small part of the sun's diameter was eclipsed.
The chord of the arch of the sun's periphery eclipsed was 14 40
Then followed frequent clouds in the intermediate spaces; then some zenith distances of the sun were taken for cor-

S f f 2

1706

1706
May 1st
St. N.
MANE

Time correct. by the pendu- lum-clock.
h. ' "

recting the clock, and after-
wards, when near the middle
of the eclipse.

The parts of the diameter re-
maining clear

5 00
4 39

Frequent large clouds again till
the sun appeared thro' the
breaks, and the eclipse was
not ended, clouds again, till
when the sun shone out again
his limb was seen entire, and
the eclipse certainly over;

At *Canterbury* Mr. *Stephen Gray* had prepared a scene placed
behind his seven foot glass; so that the species of the sun pro-
jected thereon was seven inches over, but having the same sort of
weather at *Canterbury*, as at *Greenwich*, he did not see the be-
ginning of the eclipse, by reason of clouds; but he observed
other phases and the end of the eclipse, as follows,

Cor. time
by the pen-
dulum
Clock.

h.

8 53

9 08

31

36

55

57

10 02

4

14

16

20

5 digits and $\frac{1}{2}$ darkened

— 7

— 10 or more

— the sun shining for a short time, the eclipse
seemed to decrease

— 7 $\frac{1}{2}$ a little clearer

— 6 $\frac{1}{2}$

— 6

— 5 $\frac{1}{2}$

— 4

— 3 $\frac{1}{2}$

— 2 $\frac{1}{2}$

Cor.

Cor. time by the pen- dulum clock.	
h.	'
30	— 1
31	— $0\frac{3}{4}$
10 36 $\frac{1}{2}$	— the end of the eclipse accurately observed with a 16 foot telescope.

At *Horton near Bradford in Yorkshire*, Mr. *Abraham Sharp* projected the species of the sun on a scene-plate, behind his seven foot glass, so that it appeared seven inches over; by reason of cloudy weather, he saw neither the beginning nor end, but other phases near the middle of the eclipse, as follows

Time corr. by the
Pend. clock.

h.	'	"	
8	35	00	— 3 $\frac{1}{2}$ digits dark by ocular estimation.
9	01	00	— 7 $\frac{1}{2}$ eclipsed on the scene
4	54	— 8 $\frac{1}{2}$	
6	33	— 8 $\frac{1}{2}$	
7	53	— 8 $\frac{1}{2}$	
12	50	— 9	
16	08	— 9 $\frac{1}{2}$	
18	48	— 9 $\frac{1}{2}$	exactly, the sun shining out clear
20	45	— 9 $\frac{1}{2}$	the sun still shining clearly; greatest ob- scurity
21	48	— 9 $\frac{1}{2}$	still clear
28	46	— 9	
44	45	— 7	
54	42	— 5 $\frac{1}{2}$	
10	06	10 3 $\frac{1}{2}$	digits
19	55	— 2	precisely
24	00	—	the sun seen thro' clouds, the eclipse not ended
30	00	—	the sun seen again perfectly round and entire.

At *Bern in Switzerland* captain *Stannyan* observed, that the sun was totally eclipsed for four minutes and $\frac{1}{4}$ of time; that a fixed star and a planet appeared very bright; and that his getting out of the eclipse was preceeded by a blood red streak of light from its left limb, which continued no longer than six or seven seconds

seconds of time; then part of the sun's disk appeared all of a sudden, brighter than ever *Venus* was seen in the night, and in that very instant gave a light and shadow to things, as strong as moon light uses to do.

Captain *Stannyan* is the first that ever observed a red streak of light preceeding the emerfion of the sun's body from a total eclipse, which is the more remarkable as it infers, that the moon has an atmosphere, and its short continuance of only six or seven seconds of time, shews us, that its height is no more than the five or six hundredth part of her diameter.

Observations on the Sun's Eclipse; by M. Facio Duillier.
Phil. Trans. N^o 306. p. 2241.

THERE was a total eclipse of the sun observed at Geneva on the 12th of May 1706, N. S. a little after the sun's rising, the sky seemed clear, tho' the air was already thick with some vapours; several little clouds afterwards arose here and there, and the vapours increased much; for want of a pendulum-clock, in a convenient place, the moment of the total immersion, the moment of the first emerfion, and that of the end of the eclipse, could not be accurately observed; tho' the sky was somewhat overcast, the heat of the sun was already felt, when the eclipse began; but a very sensible cold was felt, as the moon by degrees covered a greater and greater part of the sun, and as the light decreased, the eclipse was observed, only with some glasses, either darkened with smoke, or but a little transparent; and by receiving the species of the sun, thro' a six foot telescope, which inverted the objects, upon a piece of white paper, placed at some distance from the eye-glass, when the sun was near being totally dark, the bright crescent, which remained, was seen to diminish more and more upon the paper; and when that crescent was reduced to a very narrow breadth, and to a very little length, it was seen to disappear of a sudden; and in that moment the whole sun was eclipsed; at the same instant of time, the darkness which was already very considerable, became much greater; the clouds changed their colour of a sudden, and became red, and then of a pale violet; there was seen, during the whole time of the total immersion, a whiteness, which seemed to break out, from behind the moon, and encompass it equally on all sides; this whiteness was but little determined on its outward side, and was not so broad as the twelfth part of the diameter of the moon; this planet appeared very black, and her disk was very well defined, within the whiteness, which encompassed

passed it about; and whose colour was the same, with that of a white crown or halo, of about four or five degrees in diameter, which accompanied it, and had the moon for its center; *Venus* was seen at the same time, at some distance without that crown, between the east and north-east in respect of the sun; *Saturn* and *Mercury* were also seen by several, eastwards from the sun's place; and had the sky been clear, several other stars might be observed, as also *Jupiter* and *Mars*, that towards the east, and this towards the west; and so the seven planets might have been seen, almost all at once; and accordingly, some in the country had told more than 16 stars; and several people, who were on the neighbouring mountains, saw the sky starry, in some places where it was not overcast, as if it were in the night in time of the full moon; the total immersion began about $\frac{1}{2}$ past 9; the duration of the total darkness was precisely three minutes, or 180 seconds, to the moment that the first ray of the sun began to appear again, with great brightness; and this time was observed with a simple pendulum, which was afterwards compared with a pendulum clock, vibrating seconds, and regulated on the mean motion of the sun; a little before the total obscuration, one could neither read nor write; and some swallows were seen amazed looking for a resting place, and several bats flying out; in other places hens and pigeons made haste to their roosts and habitations; a little after the sun had begun to appear again, the whiteness and the crown, that encompassed the moon, entirely vanished; then the sun shewed himself more and more, at first appearing like a little crescent, which still increased, and whose concave side seemed to be terminated, by an arch; a little before the total obscuration, the country on the west side, already seemed to be overcast with darkness; and after the total obscuration, the darkness was seen to leave us more and more and fly eastwards: According to *M. Gautier's* observations, from the first emersion of the sun, to the end of the eclipse, was 1 h. 9' 30"; as to the accurate times they were uncertain, the pendulum-clock having been set only by a small sun-dial.

According to observations made on the eclipse of the sun at *Marseilles*, in the Jesuits observatory of *St. Croix*, by *M. Chazelles* and Father *Laval*.

The eclipse began at
Reached the sun's center at

h	'	"
8	28	40
9	6	11
Total		

	h.	m.	s.
Total at	9	34	15
The sun began to appear again at	9	37	9
The eclipse came again to the center at	10	12	23
It entirely ended at	10	47	50

Three stars were distinctly seen, and for three minutes one could not see to read; and their remained one bright digit, all round the body of the moon.

The latitude of the manor-house of *Duillier*, is $46^{\circ} 24'$, its longitude is $4^{\circ} 13' 45''$ to the eastward of the royal observatory at *Paris*; and *St. Peter's* church at *Geneva* is in latitude $0^{\circ} 12'$ to the southward, and in longitude $0^{\circ} 5' 2''$ to the westward of *Duillier*.

According to these observations, the altitude of the moon's atmosphere cannot well be supposed less than 130 miles of perpendicular height, of which 60 make one degree of the earth; nor could that atmosphere be discovered, before the time of this eclipse, by any refraction of the stars; probably, because of the smallness thereof, and for want of proper observations; and tho' it was very plain, that the atmosphere of the moon must needs shew itself in the time of a total eclipse of the sun, yet no body thought of it, till now, that several persons actually saw it: Some observations evince, that our atmosphere is sometimes visible, all along from the surface of the earth to the perpendicular height of one semi-diameter of the terrestrial globe and the continued appearance of a crown, of only four or five degrees in diameter, about the sun, during the whole time of the total obscuration, shews, that the æthereal matter, in which that crown was produced must be at a considerable height above the surface of the earth; but, if that crown was to be seen, so far as the weather permitted, in all the places, where the eclipse was total, it must be concluded, that the cause of it was not in our air, but in some vapours encompassing the sun; and probably, in those very vapours, which produce that pointed light, that had been observed lying in a manner along the ecliptic, and had the sun for its center: If ever such another appearance should be seen in the time of a total eclipse, it would be proper to observe accurately the least diameter of the crown from inside to inside; and whether during the whole time of the total immersion, the inward circle be every where continued, and of an uniform figure; the less the said diameter, and the greater the excess of the moon's apparent diameter above that of the sun, as also, the

the greater the apparent altitude of the sun is above the horizon, the higher the cause, which produces the crown, must be above the surface of the earth; and the position, upon the moon's disk, in reference to the zenith of the points of contact, where the sun disappears, or begins to shew itself again, is here also of some consideration.

An Account of the same Eclipse; by Dr. Scheuchzer. Phil. Transl. N° 306. p. 2246. Translated from the Latin.

AT Zurich in Switzerland, on the 12th of May we had a total and annular eclipse of the sun; total, because the whole disk of the sun was covered by the moon; but not properly annular, only so by refraction, seeing there appeared about the moon a blood-red streak of light, arising from the refraction of the rays in the moon's atmosphere,

The Beginning of the eclipse was in the morning at	h.	
The middle at	8	54
The End at	9	58
	11	12

The *Mora* of the mean and entire obscuration was 4', at which time both the fixed stars and planets were seen, the birds betook themselves to their nests, the bats began to fly about, and the fish to swim in the waters; there was felt at Zurich a sensible cold, and there fell a dew upon the ground.

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